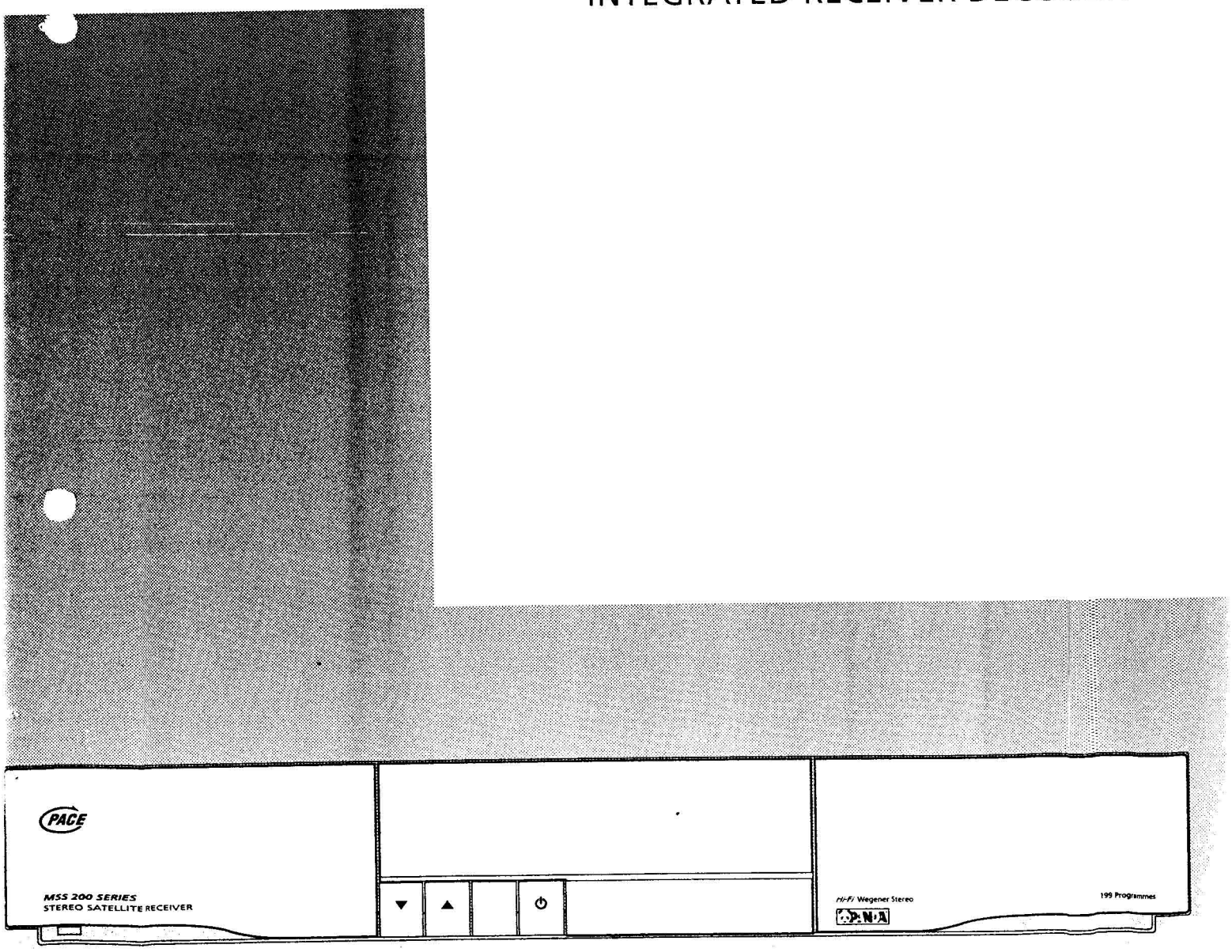
# Service Manual

## MSS 2

INTEGRATED RECEIVER DECODER




PACE MICRO TECHNOLOGY LTD

## IMPORTANT - THIS MANUAL COVERS THE MSS 200-I

PLEASE SEE THE IMPORTANT NOTES OPPOSITE

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# IMPORTANT NOTES

### NOTE 1: STATUS OF THE PRODUCT

The MSS 200-I contains one PCB (some units also have a small microprocessor extension PCB). The main PCB is currently at Revision A2. The PCB's part number is marked on the component side of the PCB. This number can be read on the appropriate the component ident diagram in this manual, where revision A2 is denoted by the characters 102 at the end of the part number. Note that there is a small number of MSS 200-I receivers in the field which have the A1 revision of PCB in them. The differences between Revisions A1 and A2 are slight, primarily involving the tracking in of some components which were retrofitted on the A1 board.

The parts lists and circuit diagrams in this manual include information from all Engineering Change Orders (ECOs) up to and including ECO S000731 and all Production Change Orders (PCOs) up to and including PCO S000351, provided that these ECOs and PCOs had an effectivity date on or before 17.08.94. Further changes will be given in technical bulletins until this manual is re-issued.

If you need to find out the software version number of the receiver, you can display the Download Menu (see page 12) and then press the STORE key to display the second Download screen, which shows the software version number.

### NOTE 2: CIRCUIT DIAGRAM

A sheet containing the main circuit diagram is in the pocket inside the back cover of this manual.

### NOTE 3: VIDEOCRYPT CIRCUIT DESCRIPTION AND DIAGRAMS

For copyright reasons, these have been printed on special paper on a separate sheet, part of which has been overprinted with broad diagonal stripes to prevent photocopying. Each of these sheets has a unique, traceable serial number. As the card reader is intimately linked with the VideoCrypt circuitry, the description of the card reader circuitry is also given on this sheet, which can be found in the pocket at the rear of the manual.

# OUTLINE SPECIFICATION

## GENERAL

| | |
|---|---|
| Number of Programmes | 199 |
| Front Panel Control | Standby, programme up/down and authorise buttons |
| UHF Modulator | CCIR PAL System I, Ch. 21 to 69, preset to Ch. 38 |
| Operating Voltage | 187 - 264 V AC, 50 Hz |
| Power Consumption | 35 W (max.) |
| Dimensions | H = 63 mm, W = 360 mm, D = 263 mm |
| Weight | 3.0 kg (typical, when packed) |

## CONNECTORS

| | |
|---|---|
| TV | SCART (RGB and CVBS) |
| VCR | SCART (CVBS) |
| DECODER/DESCRAMBLER | SCART (Baseband Output, Audio/Video Input/Output, RGB in) |
| R and L AUDIO OUT | Phono |
| MAINS INPUT | 2-pin reversible |
| AERIAL | IEC female |
| TV | IEC male |
| LNB | F-type |

## TUNER

| | |
|---|---|
| Receiving Frequency Range | Currently 920 - 2050 MHz (shortly to be 700 - 2150 MHz) |
| Polarity Switching | Vertical: 12.0 - 14.0 V, Horizontal: 16.5 - 20.0 V at 0 - 250 mA with short circuit protection |
| LNB Tone Switching | Amplitude: 0.6 V ±0.2 V, Frequency: 22 kHz ±4 kHz |
| Input Impedance | 75 Ω |
| I. F. | 479.5 MHz |
| I. F. Bandwidth | 27 MHz |
| Input Level | -60 dBm to -30 dBm |
| Image Rejection | 40 dB (typically) |
| Static Threshold | 6 dB (typically) |
| Energy Dispersion Removal | 35 dB (min.) |

## SCART CONNECTORS

| | |
|---|---|
| Video Output Level | 1 V p-p (±2 dB) |
| Video Output Impedance | 75 Ω |
| Video Frequency Range | 50 Hz - 4.8 MHz (±3 dB) |
| Video De-emphasis (PAL) | to CCIR 405.1 (625 lines) |
| Baseband Output Level | 1 V p-p (±2 dB) |
| Baseband Frequency Range | 30 Hz - 10.5 MHz (±3 dB) |
| Baseband De-emphasis | PAL/MAC/Flat/Clamped, software selectable |
| Audio Frequency Range | 30 Hz - 12 kHz |
| Audio Output Level | 500 mV rms into 10 kΩ |

## OPERATING/STORAGE CONDITIONS

| | |
|---|---|
| Operating Temperature Range | 5 - 40 °C |
| Operating Humidity Range | 20 - 80% non-condensing at 25 °C |
| Storage Temperature Range | -20 - +50 °C |
| Storage Humidity Range | 10 - 90% non-condensing at 25 °C |

## OUTLINE SPECIFICATION (cont.)

### AUDIO

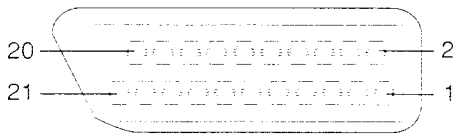
| | |
|---|---|
| Audio Bandwidth | 130, 180, 200, 280 or 380 kHz |
| Audio De-emphasis | PANDA 1, 50 µs, 75 µs or J17 |
| Tuning Frequency Range | 5.00 - 9.00 MHz in 10 kHz steps<br>left and right frequencies independently tunable |

**KU-Band preset audio modes**

| Mode | Frequency | De-emphasis | Bandwidth |
|---|---|---|---|
| Stereo A | 7.02 & 7.20 MHz | PANDA 1 | 130 kHz |
| Stereo B | 7.38 & 7.56 MHz | PANDA 1 | 130 kHz |
| Stereo C | 7.74 & 7.92 MHz | PANDA 1 | 130 kHz |
| Stereo D | 8.10 & 8.28 MHz | PANDA 1 | 130 kHz |
| Mono 1 | 6.50 MHz | 50 µs | 180 kHz |
| Mono 2 | 7.02 MHz | PANDA 1 | 130 kHz |
| Mono 3 | 7.20 MHz | PANDA 1 | 130 kHz |
| Mono 4 | 7.38 MHz | PANDA 1 | 130 kHz |
| Mono 5 | 7.56 MHz | PANDA 1 | 130 kHz |
| Mono 6 | 7.74 MHz | PANDA 1 | 130 kHz |
| Mono 7 | 7.92 MHz | PANDA 1 | 130 kHz |
| Mono 8 | 8.10 MHz | PANDA 1 | 130 kHz |
| Mono 9 | 8.28 MHz | PANDA 1 | 130 kHz |

## PIN DESIGNATIONS FOR SCART CONNECTORS

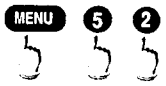
**Socket Viewed from Rear Panel**

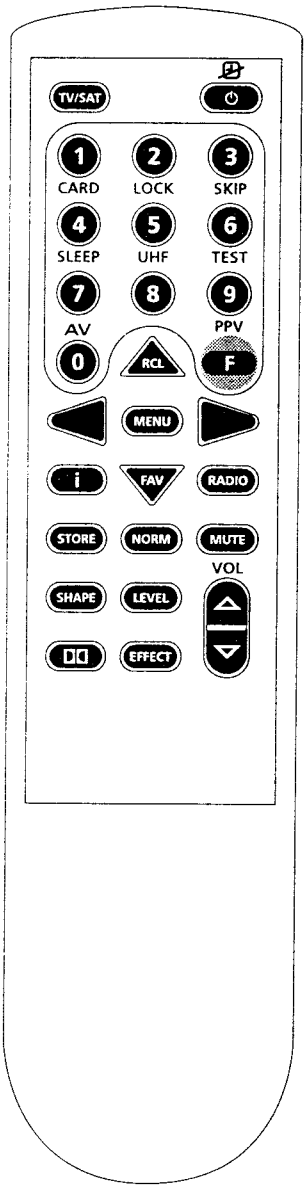



| Pin | TV SCART (SK3) | Pin | VCR SCART (SK2) | Pin | DECODER SCART (SK4) |
|---|---|---|---|---|---|
| 1 | R Audio Out | 1 | R Audio Out | 1 | R Audio Out |
| 2 | R Audio In | 2 | R Audio In | 2 | R Audio In |
| 3 | L Audio Out | 3 | L Audio Out | 3 | L Audio Out |
| 4 | Audio Ground | 4 | Audio Ground | 4 | Audio Ground |
| 5 | Blue Ground | 5 | Ground | 5 | Blue Ground |
| 6 | L Audio In | 6 | L Audio In | 6 | L Audio In |
| 7 | Blue Out | 7 | Not connected | 7 | Blue In |
| 8 | AV Status Out | 8 | VCR Status In | 8 | Ext. Decoder Status In |
| 9 | Green Ground | 9 | Ground | 9 | Green Ground |
| 10 | Not connected | 10 | Not connected | 10 | Ext. Switch |
| 11 | Green Out | 11 | Not connected | 11 | Green In |
| 12 | Not connected | 12 | Not connected | 12 | Serial Data I/O Port |
| 13 | Red Ground | 13 | Ground | 13 | Red Ground |
| 14 | Ground | 14 | Ground | 14 | Ground |
| 15 | Red/SVHS Chroma Out | 15 | SVHS Chroma | 15 | Red In |
| 16 | RGB Status Out | 16 | Not connected | 16 | RGB Status In |
| 17 | Video Ground | 17 | Video Ground | 17 | Video Ground |
| 18 | Ground | 18 | Ground | 18 | Ground |
| 19 | Video Out | 19 | Video Out | 19 | Baseband Video Out |
| 20 | Video In | 20 | Video In | 20 | Video In |
| 21 | Ground (Casing) | 21 | Ground (Casing) | 21 | Ground (Casing) |

# REMOTE CONTROL HANDSET AND FRONT PANEL CONTROLS

When an operation is described in this manual, it is often given pictorially, as shown right which means: Press the MENU key, then press the 5 key, then press the 2 key.




| Key(s): | Use: |
|---|---|
| TV/SAT | To switch between satellite TV and terrestrial TV or VCR (if the receiver, TV and VCR are connected by SCART leads) |
| ⏻ | To put the receiver into and out of standby |
| 0 to 9 | To select programmes; to move between menus (sometimes to change menu values) |
| AV 0 | To an select external audio/video (AV) source |
| RCL | To recall the last programme |
| F | F (function) key - used with the other keys to give "short-cut" methods for certain functions (e.g. LOCK) |
| MENU | To display Main Menu on screen; to move back up the menu tree to previous menus |
| ▲ ▼ | To select menu options (move within menu) |
| ◀ ▶ | To step through programmes in normal viewing mode; with F key to scan through programmes; to change values in menus |
| STORE | To store changes and leave menu to return to normal viewing mode |
| NORM | To leave menu without storing changes and return to normal viewing mode |
| i | To display programme information and help text for menus |
| FAV | To select favourite categories |
| RADIO | To select satellite radio programmes |
| MUTE | To mute the sound |
| SHAPE | To select a sound shape (treble/bass mix) NB: only if TV is SCART connected |
| LEVEL | This key has no function |
| DD EFFECT | These keys have no function |
| VOL | Volume (rocker) key |

**Front Panel Buttons**

⏻ - to switch the receiver into and out of standby.

▲ and ▼ - to step through the programmes one at a time

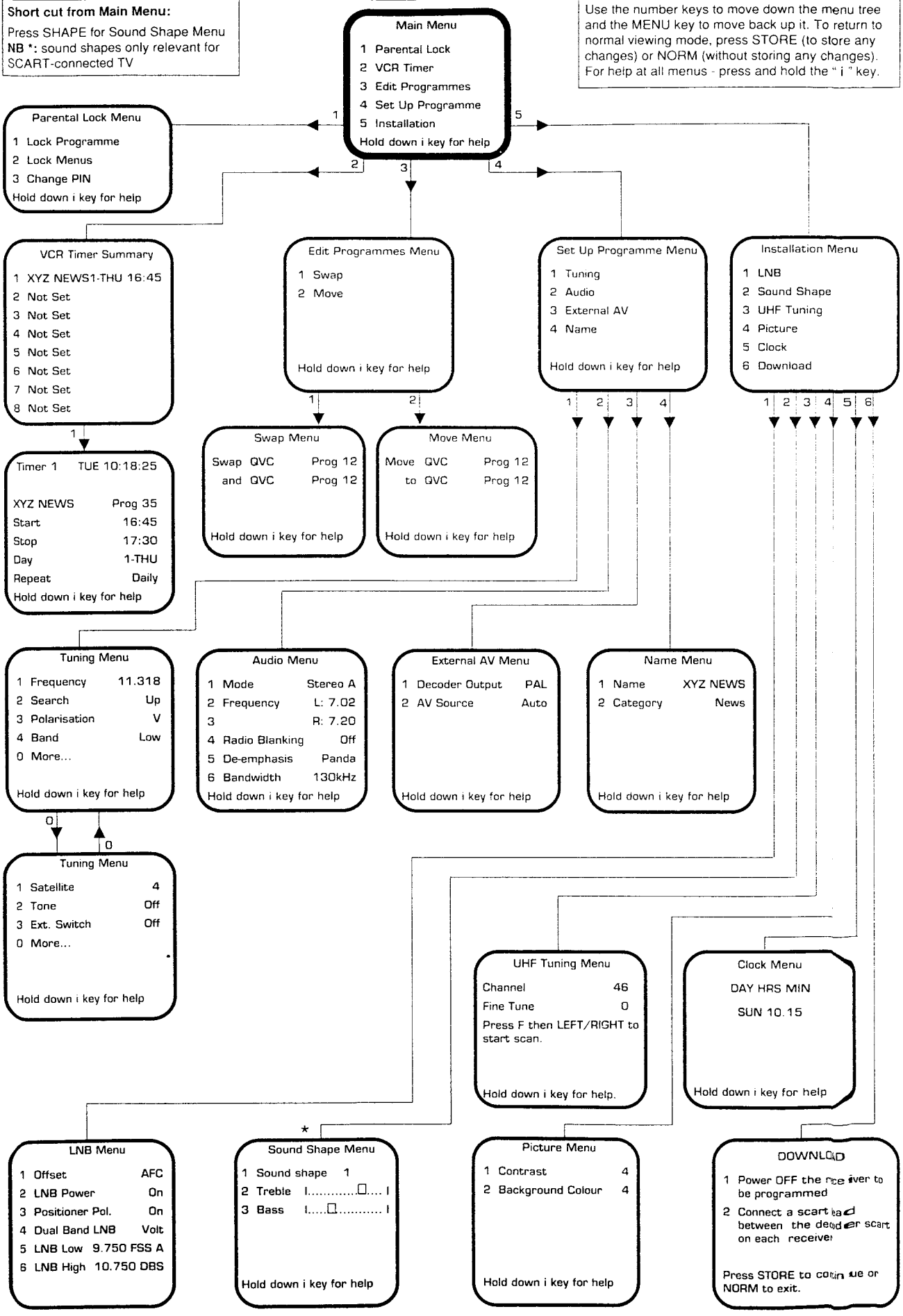
Ⓐ- authorise button for future pay-per-view TV

# MENU TREE

**Short cut from Main Menu:**

Press SHAPE for Sound Shape Menu
NB *: sound shapes only relevant for SCART-connected TV

Use the number keys to move down the menu tree and the MENU key to move back up it. To return to normal viewing mode, press STORE (to store any changes) or NORM (without storing any changes). For help at all menus - press and hold the " i " key.



# UHF TUNING

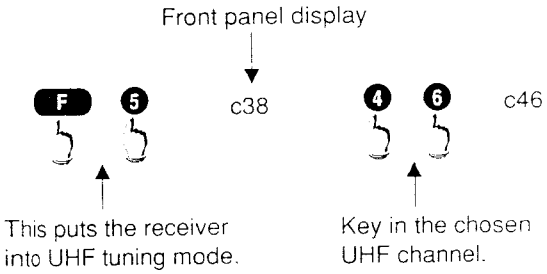
The receiver has been preset at the factory to UHF channel 38, so if you tune the TV (and VCR if necessary) to channel 38, it will automatically be tuned to the receiver. If the TV's channel 38 is not free, then you can tune the receiver to any other channel in the range 21 to 69. If the TV is UHF connected there is no treble/bass control (i.e. no sound shapes).

## Tuning the Receiver to a UHF Channel

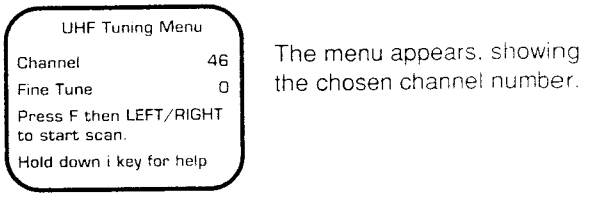
Set up the TV to the required UHF channel and assign it to one of the TV handset keys (e.g. the 5 key). If you find a clear TV channel but do not know its number you can use the "channel scan" feature - see the next section.

Plug the receiver into the mains and bring it out of standby mode.

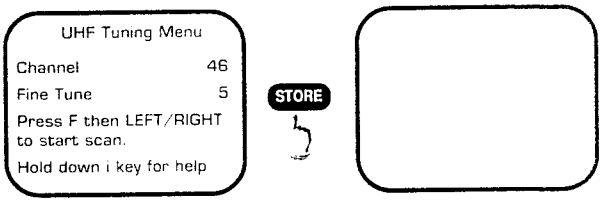
### E.g. Tuning to UHF channel 46



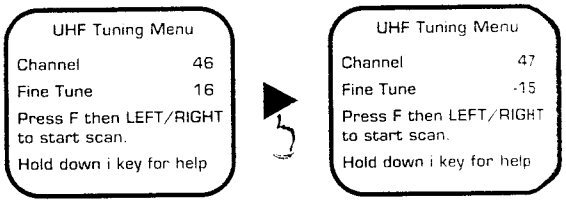

To get the best picture, you can fine tune between -15 and +16.




The menu appears, showing the chosen channel number.




Note that if the "Fine Tune" option is selected and you press the ▶ key when +16 is displayed, the fine tune value becomes -15, but the channel number increases by one as shown. A channel with a fine tune value of +16 is the same as the next channel with a fine tune value of -15.


UHF Tuning Menu
Channel 46
Fine Tune 16
Press F then LEFT/RIGHT to start scan.
Hold down i key for help
UHF Tuning Menu
Channel 47
Fine Tune -15
Press F then LEFT/RIGHT to start scan.
Hold down i key for help

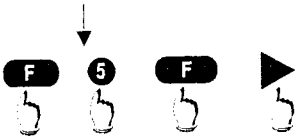
## Using the UHF Channel Scan Feature

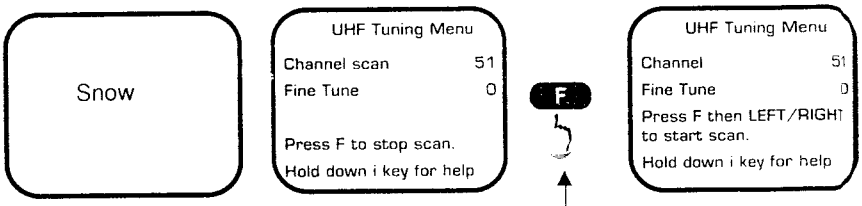
This is an alternative method for tuning the receiver to a UHF channel. It is useful if you find a TV handset key which gives a clear UHF channel, but do not know the number of this UHF channel.

The example below shows channel 51 as the UHF channel which corresponds to the chosen TV handset key.

Plug the receiver into the mains and bring it out of standby mode.

This puts the receiver into channel scan mode.




The TV screen displays only snow until the correct channel number is reached, then the menu appears.

To stop the scan

If you did not stop it at exactly the correct channel to put the menu on the screen, press the ◀ or ▶ key until you do see the menu.

The front panel display keeps changing. c38.....c43.....c51

**DON'T FORGET - fine tune if required, then press the STORE key to store the UHF tuning settings.**

# SETTING UP THE RECEIVER FOR THE ATTACHED LNB

**IT IS VERY IMPORTANT to check that the LNB option on the LNB Menu corresponds with the LNB on the attached dish antenna.**

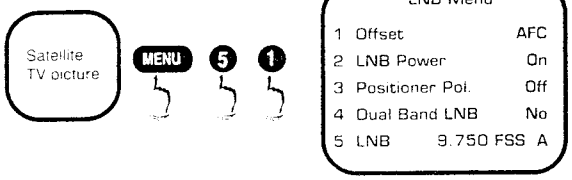
The receiver was preset at the factory as follows:

- LNB 9.750 FSS A

(i.e. for an LNB with a local oscillator whose frequency is 9.750 GHz)

Make sure you know the frequency of the LNB's local oscillator before you connect it to the receiver. Then check that the LNB option at the LNB Menu corresponds with this.

### Reaching the LNB Menu




LNB Menu

| | | |
|---|---|---|
| 1 | Offset | AFC |
| 2 | LNB Power | On |
| 3 | Positioner Pol. | Off |
| 4 | Dual Band LNB | No |
| 5 | LNB | 9.750 FSS A |

If there is a band-switching LNB, you can set the "Dual Band LNB" option to "Tone" or "Volt" (to set "Volt", you must first set the "Positioner Pol." option to "On"). The final two options in the menu then allow you to set the low and high bands to match the attached LNB.

If you set "Tone" or "Volt", a "Band" option appears in the **Tuning Menu** (but if you set "Tone" the "Tone" option disappears from the **Tuning Menu**).

LNB Menu

| | | |
|---|---|---|
| 1 | Offset | AFC |
| 2 | LNB Power | On |
| 3 | Positioner Pol. | On |
| 4 | Dual Band LNB | Volt |
| 5 | LNB Low | 9.750 FSS A |
| 6 | LNB High | 10.750 DBS |

### What can happen if the LNB is set incorrectly

If the LNB setting does not correspond with the attached LNB, there can be problems as follows:

- if you set "FSS B" at the LNB Menu and your LNB is not suitable for "FSS B" (or, conversely, you have attached an "FSS B" LNB, but set a different value at the menu) then the receiver retunes to a different frequency, so that you see a different programme or even no programme at all on the screen

  (e.g. the programme which was SKY NEWS retunes to become CNN or GALAVISION);

- in other cases the receiver does not retune (i.e. the same programme remains on the screen) but the frequency displayed at the **Tuning Menu** may not be correct.

## Changing the LNB Setting for a Single Band LNB

Select one of the following bands or choose the setting "Variable" (see below).

| LNB Band | Freq. Range (GHz) | Typical Satellites |
|---|---|---|
| 9.750 FSS A | 10.700 - 11.800 | Astra 1A, 1B, 1C, 1D / Intelsat / Eutelsat |
| 10.000 FSS B | 10.920 - 11.700 | Astra 1A, 1B, 1C / Intelsat / Eutelsat |
| 10.750 DBS | 11.700 - 12.500 | TDF / TV-Sat / Hispasat |
| 11.475 T-COM | 12.500 - 12.750 | Telecom 2A, 2B, 1C |

The numbers in the LNB band names are the frequencies (in GHz) of the LNB's local oscillator. The second column shows the frequency range over which you **should** tune at the Tuning Menu. We do not recommended that you tune outside these ranges, as performance cannot then be guaranteed.

### Changing the "Variable" Setting

Select "Var." (the number next to it flashes). Use the number keys to key in the LNB's local oscillator frequency (in the range 9.050 to 13.000 GHz).

### How to check that the LNB option is correct

Store a setting for the LNB at this LNB Menu, and align the dish with the Astra satellite.

In normal viewing mode, key in the programme number for SKY NEWS (consult the programme list), then display the Tuning Menu (by pressing MENU, 4, 1). Check if you can see the SKY logo in the picture on the screen. Check the frequency displayed in the top line of the menu.

If you can see SKY NEWS **AND** the frequency is correct (as on the programme list), then the LNB option at the LNB Menu is correct. If you cannot see the SKY logo **OR** the frequency is wrong, the LNB option has been set incorrectly.

***NOTE:** Ensure that you see SKY NEWS and **not** CNN or GALAVISION, even if the frequency displayed is correct.*

## Using a Dual-Band LNB

| LNB Type | Setting at "Dual Band LNB" option |
|---|---|
| Single-band | No |
| Dual-band, tone switching | Tone |
| Dual-band, voltage switching | Volt |

***NOTE:*** *To set "Volt", you must first set the "Positioner Pol." option to "On". If you set "Volt", you must use an electromagnetic or mechanical polarotor to switch polarisation (e.g. use the receiver with an attached Pace MSP995 dish positioner - see also below).*

When the "Dual Band LNB" option has been set to "Tone" or "Volt", the final two options on the menu allow you to set the low band (LNB Low) and high band (LNB High) of the attached dual-band LNB. The available bands are:

| Option | Available settings |
|---|---|
| LNB Low | 9.750 FSS A or 10.000 FSS B |
| LNB High | 10.750 DBS or 11.475 T-COM or Variable |

If you select "Var" for LNB High, use the number keys to key in a value between 9.050 and 13.000 GHz.

When the "Dual Band LNB" option has been set to "Tone" or "Volt", there is a "Band" option at the Tuning Menu where you must specify "Low" or "High", as appropriate to the frequency of that programme.

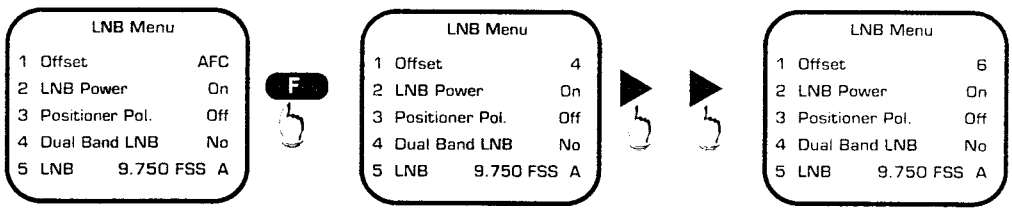
## Changing the Offset

You cannot adjust the offset until you have aligned the dish and can see some programmes.

The receiver has been factory-preset for automatic offset (called AFC). This should give a good picture with few or no speckles. You should not need to alter this unless you are trying to receive a very weak signal with a speckled picture.

***NOTE:*** *When the satellite receiver is being used with an attached dish positioner, there may be some drifting (causing poor picture quality) when AFC is on. Switch AFC off to stop the drifting.*

To override AFC, press F then set the offset between -15 to +15 to give the best picture, with an even mix of black and white speckles.




## Turning the LNB Power On/Off

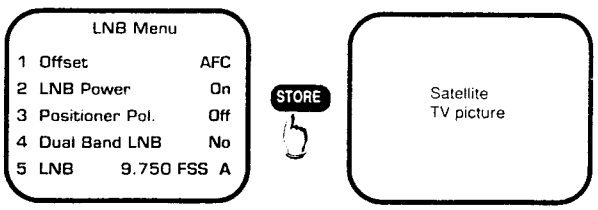
Set the "LNB Power" option to "On" to provide power to the LNB unless the LNB is on a communal antenna (in which case set "Off", as it must NOT receive power from the receiver).

## Setting the Positioner Pol. Option

Set this to "On" if you have attached a Pace MSP995 positioner and wish the polarisation you set at the Tuning Menu to pass down the SCART lead to the positioner (see also the positioner manual). In this case the receiver uses the polarotor control circuitry within the positioner to change polarisation by means of an electromagnetic or mechanical polarotor attached to the positioner. Note that this is the only means of polarisation switching available if you wish to use voltage to switch a band-switching LNB. For this reason, you can only select "Volt" at the "Dual Band LNB" option if you have first set "On" at the "Positioner Pol." option.

## Storing the LNB settings

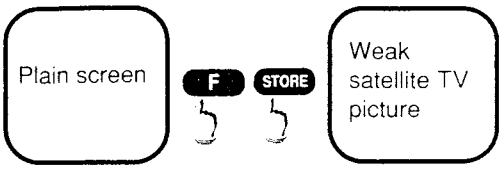
***NOTE:*** *To leave the menu without storing your changes, press the NORM key.*



# USEFUL FUNCTIONS FOR INSTALLATION

## Cancelling a Plain Screen

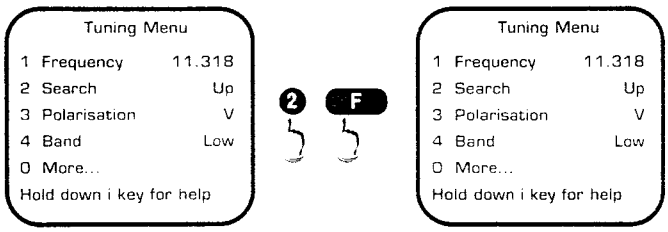
When you are tuning in to weak signals the receiver may force a plain colour onto the TV screen and display "NO SIGNAL". To help you to see weak signals, cancel this plain screen as follows, (this only works if there is no menu on the screen):




***NOTE:*** *To redisplay the plain screen, press F, STORE again.*

## Using the Fast Frequency Scan Feature

Press MENU, 4, 1 to display the Tuning Menu and start the fast scan as follows:



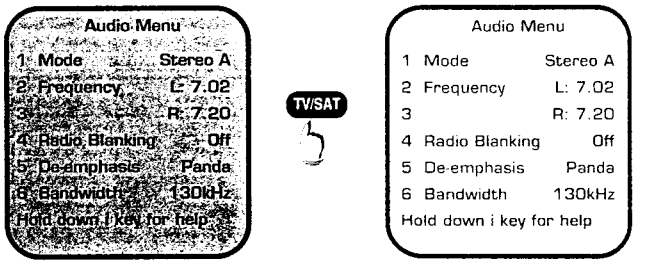

Fast scan mode

In "fast scan" mode the receiver scans quickly through the whole frequency band and weak signals do not force a plain screen. This can be a useful way to align the dish if you have no installation meter.

Look at the TV screen and move the dish until you can see stronger signals, then press the F key to stop the fast scan and return to the Tuning Menu.

## Forcing a Plain Background for Menus

Sometimes, when there is a scrambled or distorted picture on the screen, a menu may be difficult to read. You can force a plain background as follows:




distorted background

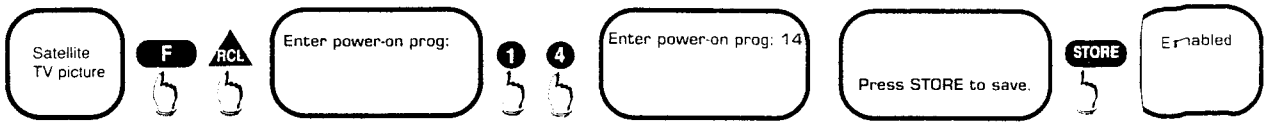
plain coloured background

***NOTE:*** *To remove the plain background, press the TV/SAT key again.*

## Setting Up the Receiver to Display a Programme when it is Powered Up

Generally when you plug the receiver into the mains it will power up in standby mode. The feature describechere can be useful if the receiver is in a communal (SMATV) system. We do not recommend it for individual installations.

The example given is for programme 14:

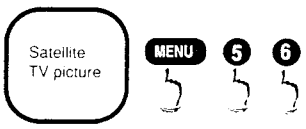


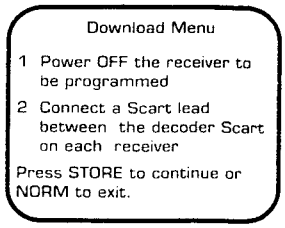

***NOTE:*** *To cancel the feature, repeat the above process.*

## DOWNLOAD

You use this feature to "program" another receiver of the same type. During the download, all of the information stored in the first receiver's internal memory is transferred to the second receiver. This includes all the settings which have been made and stored at the menus, except the clock setting and any timers that have been set up.

**Reaching the Download Menu**





Download Menu
1 Power OFF the receiver to be programmed
2 Connect a Scart lead between the decoder Scart on each receiver
Press STORE to continue or NORM to exit.

***IMPORTANT NOTE:*** *You must follow the on-screen instructions exactly, otherwise errors may occur.*

Display the Download Menu on the receiver you are downloading **from**.

Turn off the power to the receiver you want to download **to**.

Connect a SCART lead between the DECODER connector on the rear panel of each receiver.

Press the STORE key.

Turn on the power to the receiver you want to download **to**.

***NOTE:*** *The number on the screen is the software version number.*

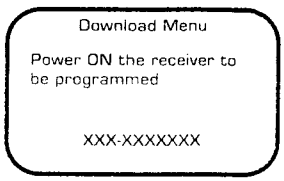
Press the STORE key.

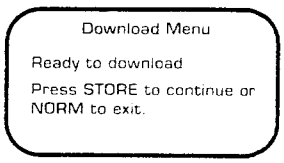
***NOTE:*** *At any stage up to this pressing of the STORE key, you can stop the download by pressing the NORM key.*

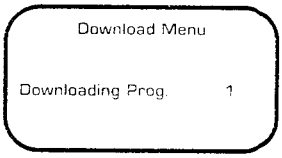
During download "global" information is transferred first, then all the programme information. Messages appear on the screen to tell you which programme is currently being transferred. Download takes about 15 seconds.

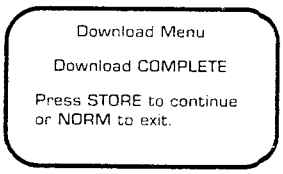
When the message "Download COMPLETE" appears, disconnect the receiver you have downloaded **to**. Press the STORE key to redisplay the Installation Menu if you wish to download to another receiver, otherwise press NORM to return to normal viewing mode.

If the download fails for any reason, the message "Download ERROR" appears.




## RESETTING THE PIN AND GLOBAL RESET

**The factory-set PIN is 1234.** You can reset any customised PIN to the factory default as follows:

At the wall socket, disconnect the receiver from the mains supply. Hold down the ⏻ button **on the receiver's front panel** while you reconnect the receiver at the wall socket. You need to hold down the ⏻ button until the symbols shown below disappear from the front panel display.

When the PIN is reset, the following also occur: any locked programmes or menus become unlocked, and, because the receiver has been powered down, the clock and any timers are no longer set.

**Global Reset**

To perform a global reset: Press the MENU key to put the Main Menu on the screen, then press the following keys in quick succession: 0 then STORE then ► then ◄.

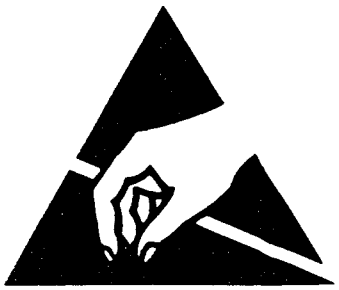
A global reset causes the following to happen:

- All the options in the "Installation" sub-menus are reset to their factory-set values.
- The PIN is reset to 1234 and, if locked, the menus become unlocked (locked programmes are not affected). As you have not powered down the receiver for a global reset, the clock and timer settings are not lost.
- The "power-on" volume is reset to "half way"; the sound shapes are reset to those depicted in the User Manual.
- If a "power-on" programme has been set (see page 11), the receiver is reset to power up into standby.
- If you have a receiver which had special preset audio modes downloaded at the factory, these are reset to the standard Astra audio modes listed on page 5.

**NOTE 1: As the UHF channel resets to 38, fine tune 0, you may need to do UHF tuning again (see page 8).**

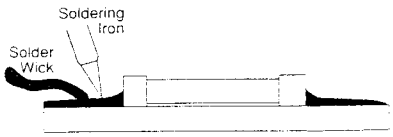
# WORKING WITH CHIP COMPONENTS

## Handling Electrostatic Sensitive (ES) Devices



Many semiconductor devices, such as integrated circuits and field effect transistors, can easily be damaged by static electricity. The following precautions should be observed when ES devices are being handled.

- Always use a grounded tip soldering iron and anti-static type solder removal devices.
- Before handling a device, discharge any electrostatic charge on your body by touching a known earth point - preferably use an earthed bench mat or ground mat together with a wrist strap.
- Do not remove an ES device from its protective packing until you are ready to fit it. Touch the protective material to the chassis or the assembly in which the ES device is to be installed, before removing the device from its packing.

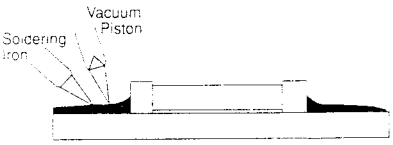



## General Precautions for Handling and Storing Chips

Do not handle chips with your bare hands as this can cause oxidation on the chip's terminals which leads to poor soldering.

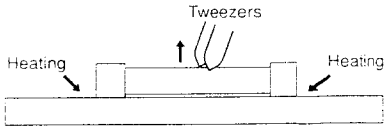
Do not store the chips in any of the following areas, as oxidation will occur and the capacitance and resistance will be affected:

- areas with sulphur or chlorine gas;
- direct sunlight;
- areas of high temperature and/or high humidity.




Rough handling of circuit boards containing surface mount devices can cause damage to the components as well as the board; never bend or flex such boards.

Do not heat or cool the boards unnecessarily, as the board materials expand and contract by differing amounts which can cause the components and solder connections to be stressed.

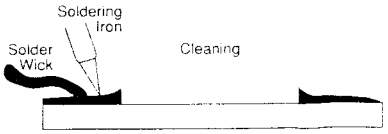



Never rub or scrape chip components as this can change their value. Do not slide the board across any surface.

## General Precautions for Attaching and Removing Chips

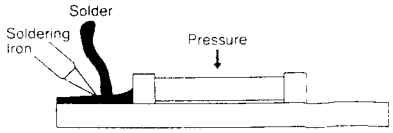
When using a soldering iron, take care and apply suitable pressure.

For preference, use a soldering iron rated at approx. 30 W with a thermostatic control to give soldering temperatures of approx. 225 to 250 °C.



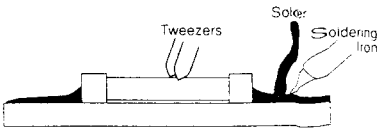

Do not re-use chips which have been removed from the board.

When attaching chips, solder as quickly as possible so as not to damage the terminals and body of the chip. Do not touch the terminals directly with the soldering iron.




While soldering, keep the chip's body in contact with the board.

## Removing a Chip




Heat the solder for 2 to 3 seconds at each terminal of the chip.

Remove the molten solder with solder wick.

Holding the chip with a pair of tweezers, remove it gently from the board while the solder at each terminal is molten.

Wick off all excess solder from the board, so that it is ready for the mounting of new components.

## Attaching a Chip

Place the chip in the correct position and temporarily solder one terminal to the copper surface.

Holding the chip body with a pair of tweezers to position it accurately, complete the soldering at each terminal in turn.

# CIRCUIT DESCRIPTION

The receiver has all its main components on one printed circuit board. Some receivers may have an extension board in place of the main microprocessor U4 (see also the section entitled "Control Circuitry" later in this circuit description)

The adjacent "main" block diagram shows the main functional blocks. The VideoCrypt circuitry is on the main PCB but, for copyright reasons, the VideoCrypt decoder functions are given in a block diagram on a separate sheet. (See the pocket on the rear cover of the manual.) This separate sheet also contains a VideoCrypt circuit diagram and descriptions of the VideoCrypt and card reader functionality. There is also a separate block diagram for the audio circuitry (on page 24).

## TUNER AND VIDEO PROCESSING

### Tuner

When a programme is selected via the handset, data received by the sensor IR1 is fed, as TTL level data, to the microprocessor U4 which in turn supplies tuning data to a frequency synthesiser within the video processor U16. This synthesiser forms the reference oscillator for the phase locked loop which controls the local oscillator in the tuner (TUNER1). The prescaler output of the tuner is obtained by dividing the local oscillator frequency by 128.

The local oscillator is set 479.5 MHz higher in frequency than the chosen programme and is mixed with the incoming signal. The signal is then amplified by an IF stage centred at 479.5 MHz with a bandwidth of 27 MHz. The 479.5 MHz FM signal is then demodulated in TUNER1 to give the required composite video baseband signal (CVBS) output.

The frequency synthesis is performed by U16, which receives divider ratio data for the required programme at pin 15 via the 3-wire serial bus from the microprocessor U4. The data is on pin 15, clock on pin 19 and select on pin 11 of U16. The synthesiser generates a reference frequency from the 4 MHz clock input on pin 12 of U16. This 4 MHz clock input is from the 16 MHz oscillator X1, which is divided by 2 in divider U22A and again by 2 in U22B. The prescaler input on pin 18 of U16 is divided down according to the divider ratio data sent from U4 and compared with the generated reference (see also the diagram on page 15). The error signal from this phase locked loop (pulses on pin 16 of U16) is integrated by Q23, C142, R193, R192 and R191. These determine how much of the 30 V supply appears as the tuner control voltage on pin 15 of TUNER1. The 5 V supply to the tuner is on pin 12.

To compensate for the LNB's local oscillator frequency conversion offsets, information on the position of the signal relative to the 27 MHz bandpass filter within the tuner passes from pin 10 of TUNER1 to pin 35 of U4. The frequency synthesised within U16 is then varied under control from U4. This automatic frequency control (AFC) keeps the signal central in the 27 MHz bandpass filter.

In dual-input models of the receiver, the Tuning Menu can be used to specify whether a programme is received via LNB 1 or LNB 2. The line LNB_1/2 controls both the supply and select for the LNBs and comes from pin 13 of U17 (the colour graphics generator IC, part of which acts as a port expander for U4). Pin 6 of TUNER1 is the select line for LNB 1 and it is enabled by Q22; pin 4 is the select line for LNB 2 and it is enabled by Q21. Power to the LNBs passes through the tuner via pin 5 for LNB 1 and pin 3 for LNB 2. There are further details about the LNB supply in the SMPS circuit description on page 21.

The baseband signal from pin 13 of the tuner is coupled into the audio circuitry via Q56. It also passes to the base of Q55. From Q55 the signal path depends on whether the receiver can be used with a C-band LNB and on whether a dual bandwidth tuner is fitted. These options are described on page 15.

If U19 (A and B), Q54 and associated components are not fitted, then C-band cannot be selected at the LNB Menu and 27/36 MHz bandwidth selection is also not available. In this case, the normal video signal passes from the emitter of Q55 via C238, J5 and R300 to pin 3 of U16.

The baseband video enters a pre-amplifier within U16. The gain of the pre-amplifier is set by R299 and R300 and the input is biased at about 2.5 V by R298 from VMID on pin 21. The pre-amplifier output on pin 2 is inverted. There are then two paths for the signal: one to give baseband output at pin 22 of U16 and the other to give video output at pin 6. See the sections "Baseband Amplification" and "Video Processing within U16" respectively for details.

## C-Band Option

Q55 is configured to give both normal video (at the emitter) and inverse video (at the collector). These pass to pins 5 and 3 respectively of U19A which is under the control of the line CBAND (from pin 12 of U17). If the LNB has been set to C-Band at the LNB Menu, the inverse video signal passes through U19A from pin 3 to pin 4. For the other LNB settings, the normal video passes through U19A from pin 5 to pin 4. (Note that U19 is a 4053 switch, a diagram of which is given on page 19.)

## Dual Bandwidth Tuner

The video signal passes from U19A via Q54 and gain switch U19B, which is controlled by the line 27/36. This line comes from the line BANDWIDTH from pin 20 of U4 via Q64 and also passes to pin 14 of the tuner. If a dual bandwidth tuner is fitted this line selects between the two bandwidth options; for a single bandwidth tuner Q64 and associated components are not fitted and the line BANDWIDTH has no function. For an 18/27 MHz tuner the video gain of the receiver is the same at both bandwidths, but for a 27/36 MHz tuner the gain must be reduced if 36 MHz is set at the Tuning Menu (as the output voltage from the tuner is increased in this case). The gain reduction is achieved using R322 and R323 to divide down and the switch U19B controls the selection between 27 MHz (where no gain reduction is required) and 36 MHz. If an 18/27 MHz tuner is fitted, R322 is zero ohms so that no gain reduction occurs.

## Baseband Amplification

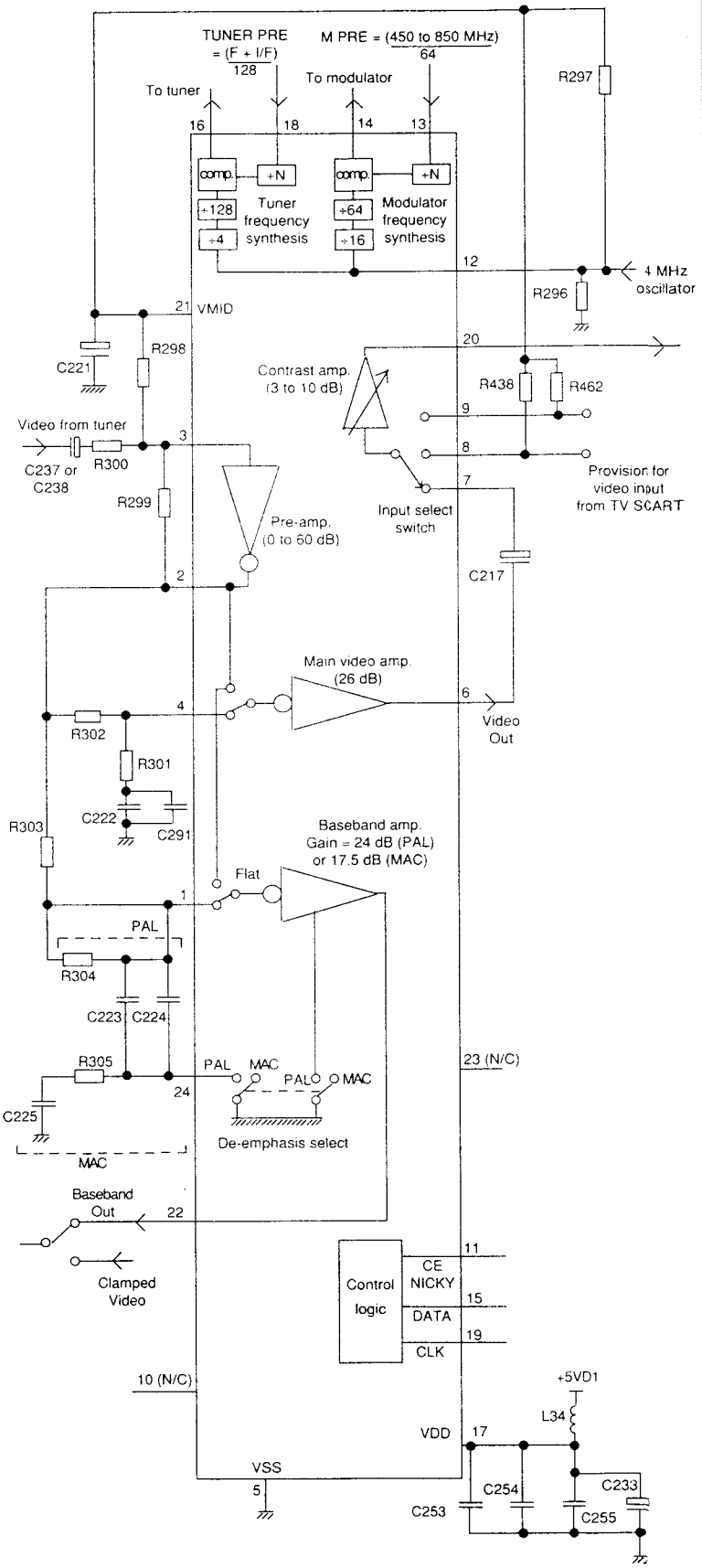
MAC and PAL transmissions use different pre-emphasis. The de-emphasis required for the incoming signal format, PAL or MAC, can be selected at the Decoder Output option of the External AV Menu (a sub-menu of the Set Up Programme Menu). This PAL/MAC selection switch is within U16 (under control from U4) and is on pin 24 of U16.

If PAL is selected, the response of the amplifier is modified by the PAL de-emphasis circuit R304, C223 and C224.

If MAC is selected, the response of the amplifier is modified not only by R304, C223 and C224 but also by R305 and C225 to give MAC de-emphasis.

The signal re-enters U16 at pin 1 and passes through the baseband amplifier whose gain is automatically reduced for MAC.

At the External AV Menu, PAL and MAC are not the only values which can be set for the Decoder Output option; it is also possible to set "Flat" or "Clamped". If "Flat" is selected, the output from the pre-amp in U16 is switched straight through to the baseband amplifier, as shown in the diagram right, thereby by-passing the PAL and MAC de-emphasis circuitry described above.



The baseband amplifier output is inverted and is on pin 22 of U16. If PAL, MAC or Flat has been selected for the Decoder Output option at the External AV Menu, the base of Q68 is at a nominal 4 V (set by R382 and R383). This is a higher level than the base of Q67, therefore the baseband output passes through Q68 to amplifiers Q53 and Q52 and then to pin 19 of SK4 (i.e. the DECODER SCART).

If "Clamped" is selected for the Decoder Output at the External AV Menu, then the control line CLAMPED_DEC_VID from pin 15 of U17 goes high, which causes Q69 to switch on and rebias the base of Q68 to 0 V. When this happens, the base of Q67 is at a higher level than the base of Q68, so that the clamped video signal from the energy dispersal clamp (i.e. from the junction of R282 and R362 - see later description) is able to pass via Q95 and Q67 and from there to the amplifiers Q53 and Q52. Therefore if "Clamped" is selected, it is the clamped video signal, rather than video from the baseband amplifier in U16, which passes to the DECODER SCART.

RTL4 decoders require the PAL video option. The receiver is also compatible with Canal + and Premiere decoders, which need the clamped video signal option.

### Video Processing within U16

In the second path, the signal at pin 2 of U16 is PAL de-emphasised by the circuit R302, R301, C222 and C291 and then re-enters U16 at pin 4. The main video amplifier re-inverts the signal which passes out of U16 at pin 6. It then goes back in at pin 7 where it forms one of three possible video inputs to the video source selection switch. Note that currently there is no source selection at this switch because pins 8 and 9 are not connected to anything, although there is provision to have an input at pin 8 from pin 20 of the TV SCART via a wire between W1A and W1B.

The video signal is fed from this switch to a non-inverting contrast amplifier within U16 which can be varied under control from U4 (i.e. settings made at the Picture Menu). The output from this amplifier at pin 20 of U16 is then filtered. Note that because the video input from the DECODER SCART does not enter U16, the contrast of programmes decoded by an external decoder is not affected by contrast adjustments made at the Picture Menu.

### Video Filter and Phase Compensation

After the video signal has been amplified in U16, it is coupled to a low pass filter comprising L30, L31, C194, C195, C196, C197 and C198 which has a cut-off point of 5.0 MHz. Q40, C200 and associated components provide phase compensation for the delay which occurs between the chroma (colour, higher frequency) signal and the luma (outline, lower frequency) signal.

### Amplifier and Sound Trap

After being filtered and phase-compensated the video signal passes through an amplifier and sound trap (Q41, Q42, L32 and associated components) to remove any residual audio sub-carriers. It then passes to the energy dispersal clamp.

### Energy Dispersal Clamp

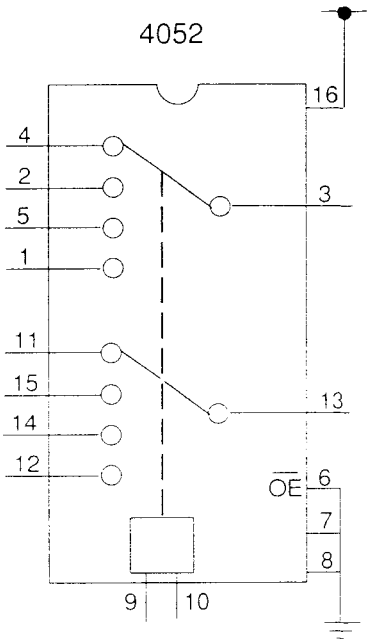
Almost all satellite transmissions are transmitted with energy dispersal to distribute the transmitted energy more evenly across the transmission bandwidth. Energy dispersal is a triangular 25 Hz waveform added to the signal. If this is not removed, a flickering can be seen on the screen.

To remove the energy dispersal 25 Hz triangular modulation, the video signal (which is AC coupled by C205) is sync. tip clamped by Q44 and Q45. The clamp reference is set by the signal CLMP_REF (which comes from the VideoCrypt circuitry) operating through Q46, R276 and R275 on the base of Q45. If the voltage level of the signal at the junction of L33 and C205 (i.e. test point for Oscillogram 4) is 0.6 V (or more) below the voltage level at the base of Q45, this begins to conduct. As Q45 turns on, Q44 starts to conduct thereby charging up C205 until Q45 stops conducting.

The clamped video signal passes via Q47 and Q48 (which provide temperature compensation to maintain the DC level) to pin 12 of U21A and also to Q95 (see section on baseband amplification above). The clamped video at the junction of L33 and C205 also passes, via Q94, into the VideoCrypt circuitry; Q94 is a buffer which prevents 14 MHz feedback from the VideoCrypt circuitry.

## Decoder Selector Switch

U21 is a 4052 switch, a diagram of which is shown right. It is controlled by both lines at pins 9 and 10, so a truth table is given below the diagram to show how connections made within the switch are controlled by the status of these lines. U21 is split into U21A and U21B.




| pin 9 | pin 10 | connections |
|---|---|---|
| high | high | 3 to 4, 13 to 11 |
| high | low | 3 to 2, 13 to 15 |
| low | high | 3 to 5, 13 to 14 |
| low | low | 3 to 1, 13 to 12 |

At U21A, pins 11 and 15 are connected together and are the input from pin 20 of the DECODER SCART (i.e. the **external** video input). This input is labelled EXT_DEC in the circuit diagram and is biased to mid-rail by R42 and R43. The truth table shows that whenever pin 9 of U21A is high, this external input will be switched through to pin 13 of U21A. Pin 9 is controlled by the line INT/EXT VIDEO from pin 4 of the audio processor U14, which in turn has received information from the main microprocessor U4 about the status of the DEC_STAT line (pin 8 of the DECODER SCART). As the external video signal is also fed to pins 2 and 4 of U21B (which are connected together), when pin 9 is high the external video is also switched through to pin 3 of U21B (and from there to the sync. separator).

Whenever pin 9 of U21 is low, either pin 12 or pin 14 of U21A becomes connected to pin 13. Pin 12 is the video directly from the energy dispersal clamp; pin 14 is the video from the internal VideoCrypt decoder (i.e. both are **internal** video inputs). These pins are under the control of the VC_STATUS line, as described in the next section.

## Sync. Separator

The video signal which passes via Q94 into the VideoCrypt circuitry (see description on the separate sheet) is switched through U21B provided that pin 9 of U21 is low (i.e. internal video is selected). It is then buffered by Q16 and AC coupled by C108 into pin 19 of U12, the sync. separator. U12 has a phase locked loop with a free-running VCO which uses the ceramic resonator X3; if not locked, this will generate free-running horizontal (HSYNC) and vertical (VSY) sync. pulses.

If a valid video signal is detected at pin 19 of U12 the following happen:

- the horizontal and vertical sync. pulses are locked to the video;
- the line ID_HSYNC emerging at pin 7 of U12 is a "station ID" line which goes high to 12 V (subsequently divided down to 5 V by R155 and R159) to show that the receiver has locked onto a signal (this line also controls other functions in the video circuitry - see the descriptions which follow).

The horizontal and vertical sync. pulses (on pins 12 and 15 respectively of U12) are needed for the VideoCrypt functions and are also fed to pins 18 and 19 respectively of U17, the colour graphics generator (see below).

At U21A, switching is under the control of the VC_STATUS line from pin 4 of U9 in the VideoCrypt circuitry (inverted by Q72). Non-scrambled signals are switched through from pin 12 to pin 13 (when VC_STATUS is low), whereas descrambled signals emerging from the VideoCrypt circuitry are switched through from pin 14 to pin 13 (when VC_STATUS is high). The VC_STATUS line also goes from U9, via switch U5 (see page 23 for further details on U5), to pin 31 of the main microprocessor U4 where it is used, together with other information, for card reader selection, if more than one card reader is fitted.

As an aid to trouble shooting, you can force all the signals to pass through the VideoCrypt path by grounding test point TP1 (i.e. the base of Q72).

## Circuitry between the Decoder Selector and the Graphics Generator

The selected video output at pin 13 of U21A passes through Q50 and Q49, which form an amplifier with a gain of approximately 3. The signal is then AC coupled by C216 and clamped again by Q79 to give a sync. pulse bottom voltage of approximately 1.4 V, as required by the graphics generator IC U17, where the video signal enters at pin 10.

The video signal to the VCR SCART feeds off at the junction of C216 and Q79 so that any on-screen graphics (e.g. the word MUTE) are not recorded. At this point the video signal is nominally 2 V peak-to-peak. It is buffered by Q51 which drives the output pin (19) of the VCR SCART. Note that video to a UHF-connected VCR can contain on-screen graphics which **will be recorded**.

## Colour Graphics Generator

This is U17 and associated components; it is used to generate the menu background colour and on-screen text characters, under control from the microprocessor U4. There is a choice of eight menu background colours, chosen at the Picture Menu. There are three graphics modes: plain background, superimposed on a programme and superimposed on noise.

There are two oscillators associated with U17. The first oscillator is the crystal X6 which generates a frequency of 17.734 MHz. This is exactly 4 times the frequency of the colour information which is used to generate the background colour(s) and is therefore relevant to plain background mode. If this frequency is not within a few hundred hertz of 17.734 MHz, there may be no colour to the on-screen graphics display (it depends on the tolerance of the TV set). The second oscillator is within U17 and it runs at approximately 7 MHz, its frequency being set by external components L16, C127 and C207. This is used, together with horizontal and vertical sync. pulses, to generate the characters and their positions on the screen. For the superimposed on picture mode the horizontal and vertical sync. pulses come from U12 and enter U17 at pins 18 and 19 respectively. For plain background mode the horizontal and vertical sync. pulses are generated within U17. For both these modes, the white level for the characters is generated by resistors R284 and R528 on pin 9.

The video signal which enters U17 at pin 10 therefore emerges at pin 8 with any superimposed graphics such as menus, programme status information etc. The signal is then AC coupled by C261 and rebiased to approx. 5 V by R465. The video output from U17 is also fed to Q91 which extracts sync. pulses; this is used when graphics are required on noise (see below).

The rebiased video signal at the junction of C261 and R465 is buffered by Q63 and is divided by 2 by R353 and R354 to give a nominal 1 V peak-to-peak video signal, which is then fed via C244 to the source select switch U20.

For a valid video signal, the ID_HSYNC line from pin 7 of U12 is high and U4 generally commands U17 to superimpose graphics onto a picture for the Tuning Menu (and similar menus). However, if you press the TV/SAT key while the menu is displayed, U4 commands U17 to insert a plain coloured background instead of the picture (see also page 11).

Note that part of U17 is also used as a port expander for U4.

## On-screen Graphics without a Valid Video Signal

When there is no valid video signal, the ID_HSYNC line from pin 7 of U12 is low and the microprocessor U4 is informed (pin 39). Generally, if the line is low, U4 sends a message to U17 via the data bus to switch in a plain screen with the words "NO SIGNAL" on it. However, if you have pressed "F, STORE" (see page 11), this plain screen is cancelled and noise can be seen as described below.

U4 sets U17 to a "black background" mode, which is similar to the plain coloured background mode. In this black background mode, U17 generates its own sync. pulses and outputs a video signal on pin 8. The sync. pulses are extracted from this video signal by Q91, which operates in a self-biasing high-gain amplifier mode. The sync. pulses are then coupled to Q92 via D58 (which is a DC shifter). Q92 is enabled by the line GR_ON_NOISE (from pin 14 of U17) being low.

The video signal (noise in this case), which is labelled VCR_VID in the circuit diagram and comes from the junction of C216 and Q79, is fed onto the base of Q93 via R533 and C279. The DC level of the base of Q93 is set by R542 and R543 to a nominal 7.5 V. This causes Q63 to be reverse biased and therefore switched off, so that the noise signal is fed out to the normal video path.

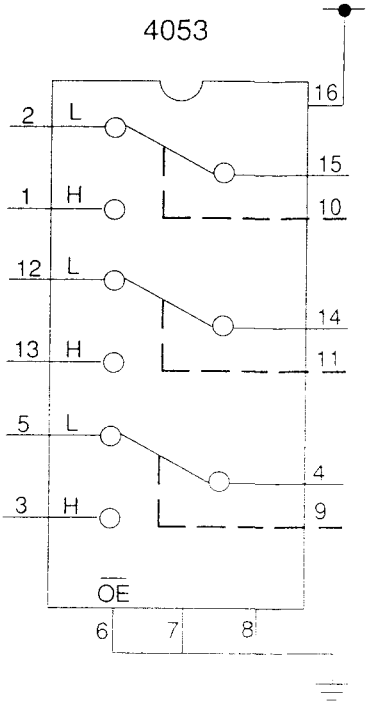
However, when a sync. pulse is extracted by Q91, it causes Q92 to switch on and therefore to rebias the base of Q93 to 0 V, which in turn switches Q93 off and allows Q63 to switch on. This enables the sync. pulse, being generated by U17, to be passed through, effectively adding the sync. pulse to the noise signal.

As explained above, Q63 is normally off during the passage of the noise signal, but the peak white graphics signal is capable of switching Q63 back on, thereby effectively adding the graphics to the noise. The white level is increased from its normal amplitude by Q90 being switched off.

When the line GR_ON_NOISE is high, Q92 is always on and Q93 always off so that the noise signal cannot progress to the normal video path towards U20.

## Video Source Selection and SVHS Chroma Switch

The source selection switch is U20. This is a 4053 switch, a diagram of which, showing the switch positions and control lines, is given right. R361, R360 and C247 provide common bias voltages for the satellite and VCR SCART video inputs to the switch via R358 and R359 respectively.




The satellite video signal from the emitter of Q63 is at pin 1 of U20 and is switched through to pin 15 if pin 10 is high. This occurs if the line VCR/SAT from pin 5 of the audio processor IC U14 is low (as it is inverted by Q62, which also acts as a level converter to convert signals at 5 V to 14 V). As pins 9 and 10 of U20 are connected together, if pin 10 is high so is pin 9 and therefore the input on pin 3 of U20 is switched through to pin 4. In this case the "red in" at pin 15 of the decoder SCART SK4 is connected to pin 15 of the TV SCART, via Q66.

If pins 10 and 9 of U20 are low then the video input at pin 2 of U20 (which comes from pin 20 of the VCR SCART) is switched through to pin 15 of U20, and pin 15 of the VCR SCART (SVHS Chroma) is switched through, via pins 5 and 4 of U20, to pin 15 of the TV SCART. This means that video cassettes recorded on an SVHS VCR play correctly and the improved quality which SVHS gives is not lost.

The output at pin 15 of U20 passes via amplifiers Q61 and Q60 and is DC coupled to pin 19 of the TV SCART via R341.

It is the main microprocessor U4 which determines whether the VCR/SAT line is high or low. U4 reads the line VCR_STAT which comes from pin 8 of the VCR SCART and enters U4 via switch U5 (see page 23 for further details on U5); this line goes high when the VCR is set to play (as opposed to record). U4 can act on this information and switch the VCR signals through to the TV by means of the VCR/SAT line. U4 only looks for a change of status in the VCR_STAT line and may set the TV_STAT line to follow VCR_STAT (although depending on other factors it may not always do this).

## Output to the Modulator and Optional AV Sockets

The video at the collector of Q60 (labelled TVVID in the circuit diagram) also passes via a sound trap comprising L38, C245 and C246 to the UHF modulator. It also passes via R475 to pin 2 of SK6, which is the video output of the AV phono sockets which are fitted on some models of the receiver.

Note that because this video to the modulator is fed off from a point by the TV SCART, it can contain on-screen graphics which will be recorded if a VCR is connected to the receiver by a UHF lead. (Video to the VCR SCART cannot contain on-screen graphics, as described on page 17).

## RGB Disable Switch

Pins 12, 13 and 14 of U20, are used to enable/disable the RGB status line of the TV SCART (pin 16). These pins are controlled by the line 16-INHIBIT which is fed via inverter and level converter Q71 to pin 11 of U20. 16-INHIBIT comes from pin 6 of port expander U26 and is high (i.e. pin 11 of U20 is low) when menus are displayed and when the VCR is playing. When pin 11 is low, pins 12 and 14 of U20 are connected together so that pin 16 of the TV SCART, driven by emitter follower Q57, is grounded and RGB is disabled.

When pin 11 of U20 is high, pins 13 and 14 are connected together so that pin 16 of the DECODER SCART and pin 16 of the TV SCART are connected and the status of pin 16 of the DECODER SCART is therefore copied to pin 16 of the TV SCART.

In practical terms, RGB from the DECODER SCART (pins 15, 11 and 7 respectively) are present at the TV SCART (note the switching of red, as described above), but can only be used by the TV if the RGB status line on pin 16 goes high (for example if a video source is connected to the DECODER SCART).

## Relay Driver

The receiver can be used to drive auxiliary relays if required because pin 10 of the DECODER SCART can be set to 14 V if required. This is enabled by setting the "Ext. Switch" option at the Tuning Menu to "On". The microprocessor U4 then sets the line REL_DRV (at pin 13 of port expander U26) high so that Q85 and, in turn, Q86 are turned on. This results in pin 10 of the DECODER SCART being connected to 14 V through R461.

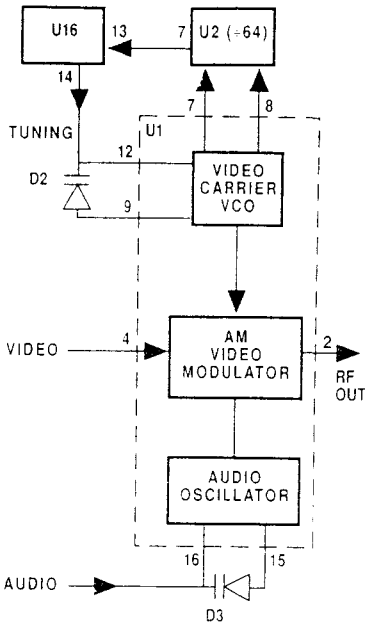
## UHF MODULATOR

The RF output to the TV is generated by a frequency synthesised UHF modulator. This allows the RF output to be precisely tuned to any channel within the UHF bands IV and V (channels 21 - 69).

The circuitry consists of two main parts, a loop-through amplifier between the aerial input and the output to the TV/VCR, and the UHF modulator itself, which comprises U1, U2 and associated components. The circuitry requires two power supply inputs, one to supply the loop-through amplifier (+14 V, which is always active) and one to supply the UHF modulator itself (+5 VMOD, which is powered off in standby mode).

The heart of the modulator is the IC U1, a block diagram of which is shown adjacent. It comprises the following:

- a voltage controlled oscillator (VCO) that covers the full UHF band;
- an amplitude modulator to modulate the UHF carrier with the video;
- an audio oscillator for the sound sub-carrier;
- a video automatic gain control and clamp to ensure the correct modulation index.




The VCO within U1 is completed by the tuned circuit connected to pins 9,10,12 and 13 of U1.

Tuning is enabled by a DC tuning voltage in the range 0 to 24 V being applied to the varicap diode D2.

Differential outputs from pins 7 and 8 of U1 are fed to pins 3 and 2 respectively of prescaler IC U2, which divides the VCO frequency by 64. The output from pin 7 of U2, which should be in the range 7.1875 MHz to 13.4375 MHz, is fed into the frequency synthesis part of the UHF modulator's phase locked loop circuitry within U16 at pin 13 (see also the diagram of U16 on page 15).

The tuning voltage is derived from pulses on pin 14 of U16. They are integrated by C48, R29, Q4, Q3 and associated circuitry and eventually fed to the cathode of D2.

The audio subcarrier oscillator tuned circuit is connected across pins 15 and 16 of U1. This is set at the audio subcarrier frequency (6 MHz for PAL I; 5.5 MHz for PAL G). The audio signals from pins 25 and 26 of the audio processor U14 are combined by R222, R223, Q36 and associated components and fed to the varicap diode D3 which causes the oscillator to be frequency modulated. D3 is biased at approximately 5.6 V by Zener diode D5. Audio pre-emphasis is provided by C154 and R226 on the emitter of Q36 (which are in the audio circuitry near U14).

The video signal (labelled TVVID in the circuit diagram) passes via L38, which, together with C245, C246 and R357, forms an additional sound trap and is fed (as MOD_VID) into pin 4 of U1 via a video filter C40, L8 and C39. This is used to amplitude modulate the VCO output. The modulation index is set to be 80% by resistor R25 on pin 3 of U1.

The output from pin 2 of U1 is fed via a high pass filter (C18, L4 and C17) and a resistive pad (R19, R18 and R17) into a balun L3 which mixes the signal with the terrestrial video signals.

The loop-through amplifier comprises Q1 and Q2. Inputs from the terrestrial antenna pass through a resistive pad (R8, R6 and R7) and a 27 MHz high pass filter C4 and L2. Lightning protection is provided by D1. There is also further high pass filtering by C3, L1 and C2. RF and DC feedback are provided by R3. The output of gain stage Q1 is then fed through another resistive pad (R33, R9 and R34) to give good reverse isolation. RF and DC feedback for Q2 are provided by R10. The output from Q2 feeds the balun L3 and passes to the TV via the rear panel UHF connector. This balun prevents the remodulated satellite signals being sent to the aerial input and thereby being broadcast. Note that a high level terrestrial signal input (e.g. if an aerial amplifier is used) can attenuate the satellite signal output.

## SWITCH MODE POWER SUPPLY

### Mains Input and Rectification

Diodes D4, D6, D7 and D8 rectify the AC mains voltage and, together with smoothing capacitor C54, provide the DC input HT for the SMPS. C53 and T1 form a mains filter to minimise the feedback of RFI into the mains supply. Asymmetrical mains pollution is reduced by the insertion of R68 and C62 between the primary ground and the secondary chassis ground. These components are required to satisfy the mains isolation requirements and are safety-critical components (as are SK1, FS1, and T2). These components (and R49 which limits the surge current on power-up) must only be replaced by components of the correct type (see parts lists).

### SMPS Controller U3

The start-up supply for U3 is obtained via R50 and R392 which charge C58 to approximately 6 V before U3 will power up. C58 sustains a charge long enough for the switch mode to reach its operating frequency. The supply for U3 is subsequently obtained from a feedback winding of the transformer T2, rectified by D11.

The frequency of the switch mode is set by R57, C55 and C64 and should be 22 to 25 kHz.

Regulation is via the feedback winding which is rectified by D12 and set by R54, R55 and R56 to give a voltage of 2.4 V at pin 8 of U3 when the supplies are at their specified voltages (5 V, 14 V etc.).

The switching transistor for the switch mode, Q5, is driven from pin 5 of U3 via R51. A negative supply, generated by D13 and limited to 4 V by Zener diode D14, is used to switch Q5 off. Excess energy from the switching of Q5 is dissipated in a snubber network R61, R60, D9, D10 and C57. Overcurrent protection is implemented by R59 and R58.

### Secondary Windings of T2

The secondary windings of the transformer T2 provide the following after rectification: +5 VD1 (pin 10), +14 V (pin 8), +18 V (pin 4), and +30 V (pin 2). The LNB supply is derived from the +18 V or +14 V supply, depending on the polarisation. The tuning voltage is derived from the +30 V supply. The +8 V supply on pin 39 of U14 is derived from the +14 V supply using D37. The 12 V supply required for the sync. separator (U12) and in the VideoCrypt circuitry is produced from the +14 V supply using Q20 and associated components. The 30 V supply is reduced to a nominal 27 V by D42, to provide the 27 V (switched) voltage required by the card reader circuitry (see also about reset on page 23).

### LNB Supply Switching

The LNB supply can be switched off under the control of the line LNB_OFF from pin 14 of U26 and occurs if there is an LNB short (see below). The status of the line LNB_OFF is also determined by the setting made at the "LNB Power" option at the LNB Menu (and, for dual input receivers, the setting at the "LNB" option at the Tuning Menu - i.e. the LNB_1/2 line).

The LNB supplies are switched and regulated by Q25 (and also Q24 for a dual input model). The required LNB voltage is switched to the base of these transistors which act as emitter followers. The LNBs are switched off by Q27 and Q28 being switched on, which in turn pull the base voltages of Q25 and Q24 respectively to zero. For dual input models, only one LNB is powered at any one time, the control for this being via the LNB_1/2 line which switches Q21 and Q22. These transistors are also used to switch the power to the appropriate LNB pre-amp within the tuner.

Dual input tuners require the LNB voltage for the bottom input ⅄ 1 (i.e. LNB 1) to be fed to pin 5 of the tuner and the voltage for the top input ⅄ 2 (i.e. LNB 2) to be fed to pin 3. Single input tuners require the LNB voltage to be fed to pin 5 (despite the fact that this input is labelled ⅄ 2).

### LNB Short-Circuit Detection

The LNB current is monitored by Q29 and R208. In an overload condition such as an LNB short, the voltage developed across R208 is sufficient to switch on Q29, which in turn causes the line LNB_OVERLOAD to go high. When this occurs the LNB_OVERLOAD line informs, via U5, the main microprocessor U4 which switches off the LNB supply via the LNB_OFF line and also causes the message !!WARNING!! LNB SHORT to be displayed on the TV screen. Thereafter, the software keeps switching the LNB power on for about 10 ms and off for 2 s to check whether the short-circuit is still present.

### Polarisation Switching

The setting of horizontal (H) or vertical (V) polarisation at the Tuning Menu causes the control line H/V from pin 15 of U4 to switch Q32. Q31 and Q30 in the PSU circuitry "on" or "off". If Q30 is "on" then the LNB supply is 18 V (which is required for horizontally polarised signals). In addition, Q26 switches off thereby adding a further 5.1 V (from Zener diode D33) to the LNB reference voltage applied to the bases of Q25 and Q24. Emitter-base compensation is provided by D29 and D30 which also allow the independent switching of the LNBs.

If switch Q30 is "off" then the LNB supply is 14 V (for vertical polarisation). Q26 is switched on which prevents the voltage from D33 being added to the LNB voltage reference.

### Voltage Switching for a Dual-Band LNB

If the "Dual Band LNB" option at the LNB Menu is set to "Volt", then the H/V line controls LNB switching as described above, but the 18 V and 14 V are used to select the high and low bands respectively of a dual-band LNB. To select "Volt" at the LNB Menu, you must first set the "Positioner Pol." option to "On". This controls the line DISH_POS from pin 38 of microprocessor U4 to pin 12 of the DECODER SCART, so that the polarisation value (H or V) for a programme is passed to an attached dish positioner. This contains polarotor control circuitry for an electromagnetic or mechanical polarotor, which switches the polarisation.

### 22 kHz Oscillator and Tone Switching

Q35, Q34 and associated components form a 22 kHz oscillator which runs constantly. The 22 kHz signal from the oscillator is used as a tone which can be switched to the LNB supply by Q33, which is controlled by the line TONE from pin 16 of the main microprocessor U4. The status of the TONE line is determined by setting the "Dual Band LNB" option to "Tone" in conjunction with the "Band" setting at the Tuning Menu. Alternatively, if the "Dual Band LNB" option is not set to "Tone", the status of the TONE line is determined by setting "On" or "Off" at the "Tone" option in the Tuning Menu.

### Power Supplies During Standby

When the receiver goes into standby, the STBY line from pin 5 of port expander U26 goes low, turning transistor Q6 off which therefore means that there is no 5 V supply (+5VMOD) to the modulator itself, but the 14 V supply to the loop-through amplifier in the modulator circuitry remains, so that terrestrial signals can continue to be routed through the satellite receiver when it is in standby.

## CONTROL CIRCUITRY AND DISPLAY

### U4 Extension PCB

The main component in the control circuitry is U4 which is based on the Z8 microprocessor. In some receivers U4 is a custom-masked single component, but in some receivers it could be a small extension board containing a standard microprocessor and a separate ROM. This extension board contains six capacitors (C1, C2, C3, C4, C5 and C6), three ICs (U1, U3 and U4) and 16 MHz crystal X1. The circuit and component ident diagrams for this board are given adjacent; a parts list is given at the end of this manual. Note that the C3, C4, C5, C6, U1, U3 and U4 in this list are quite different from the components with those names which are on the main PCB. When the extension board is replaced by the custom-masked U4, X1, C86 and C87 on the main board are fitted.

## U4 Functionality

U4 runs with a 16 MHz clock generated by crystal X1 to perform the following:

- it detects and decodes the codes received via the IR beam from the handset and those from the front panel buttons;
- it controls and sends text to the on-screen graphics IC;
- it controls the frequency synthesis loops for the tuner and UHF modulator;
- it controls the routing of the video and audio signals;
- it controls other switching functions such as the LNB supply switching;
- it activates the front panel 3-character display.

U7 is an E²PROM which is used to store information which is set at the on-screen menus. U26 is a shift register which acts as a port expander for U4. The graphics generator IC U17 also acts as a port expander for the control lines CBAND, CLAMPED_DEC_VID, GR_ON_NOISE and LNB_1/2. There are also two control lines from the audio processor U14 (IN/EXT VIDEO and VCR/SAT).

There is also port expansion at U5, a 4052 switch, which constantly "scans" the front panel buttons to see if any have been pressed and also scans the control lines at pins 2, 4 and 5. The switching is controlled by pins 9 and 10 which, as they are connected to pins 25 and 26 of U4, go high and low at the same rate as the character-scanning of the 7-segment display. Pin 12 of U5 informs U4 whether the receiver is a single or dual input model: for a single input model jumper link J7 is fitted, so that pin 12 is earthed; for a dual input model J7 is not fitted, so pin 12 is open-circuit. Pin 1 of U5 informs U4 whether the receiver is suitable for C-band: for a C-band receiver jumper link J4 is fitted, so that pin 1 is at 5 V; for a non-C-band receiver J4 is not fitted, so that pin 1 is open-circuit.

## Control Lines

A block diagram of the serial bus interconnections is shown adjacent. Some of U4's control functions occur via these lines; others have specific control lines which are described at the relevant points in the circuit descriptions. Some lines (e.g. LNB_OVERLOAD, via U5) are inputs to U4 to inform it of conditions arising in the hardware. The line DEC_STAT is an input which informs U4 that pin 8 of the DECODER SCART has gone high. The line VCR_STAT is described on page 19. The TV_STAT line is always an output from U4 and is also mentioned on page 19.

## Reset

A reset is applied to all the microprocessors within the unit (i.e. U4, U14 and U8 and U10 in the VideoCrypt circuitry) when the +5 V supply falls to approx. 4.75 V. Transistor Q7, which is turned on at the full 5 V, switches off when the supply drops. This switches Q8 on, which discharges the reset capacitor C83 and applies the reset to the microprocessors. If the reset line (RST) is low Q9 and Q10 also switch off; this removes the +27 V (switched) supply voltage to the card reader circuitry.

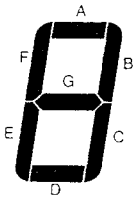
## 3-Character Display

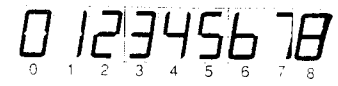
Pins 25, 26 and 27 of U4 determine which of the 3 characters illuminates at any given time (although the switching is done so quickly that they appear to be illuminating simultaneously). U6 determines which of the 7 segments (A to G) in each character are illuminated. The input to pins 6, 2, 1 and 7 of U6 comes from U4 as a binary coded decimal number - see the diagrams and table right.

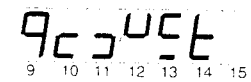
Example: When 35 is displayed, as seen at pin 2 of U6, there is H (for leading blank), then L (for 3), then H (for 5), so an oscillogram would show a trace which is low for one third of the period - see also Oscillogram 21 (which shows the trace at pin 2 when 1 is displayed - again it is low for one third of the period).

Pin 28 of U4 and Q14 enable the central segment of the display to be illuminated independently in standby, as this facility is not available from U6.

On the main board, there is the provision to fit four front-panel LEDs instead of the 3-character display, if this should be required in some models.




| Display (BCD number) | Pin of U6 6 | 2 | 1 | 7 |
|---|---|---|---|---|
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | L |
| 5 | L | H | L | H |
| 6 | L | H | H | L |
| 7 | L | H | H | H |
| 8 | H | L | L | L |
| 9 | H | L | L | H |
| 10 | H | L | H | L |
| 11 | H | L | H | H |
| 12 | H | H | L | L |
| 13 | H | H | L | H |
| 14 | H | H | H | L |
| 15 | H | H | H | H |

## AUDIO PROCESSING

Please see the main circuit diagram and the adjacent audio block diagrams.

### Demodulation, De-emphasis and Panda Noise Reduction

All of these functions are carried out by the audio processor IC U14. The baseband signal from pin 13 of the tuner is buffered by Q56 and filtered by a bandpass filter of frequency range 5 - 9 MHz (comprising Q39 and associated components). The filtered signal then enters the audio processor U14 at pin 58 and is digitised. All functions are then carried out digitally within the chip, under the control of the main microprocessor U4. The audio processor has two independent digital oscillators to tune the audio subcarriers independently.

### SCART Input Selection

Audio signals from the SCART connectors enter the audio processor and are digitised for input pre-processing and so that volume, treble and bass adjustments can be carried out on them.

There is also a 7 line path which routes the incoming signals from the SCARTs directly through U14 if they require no adjustment. Note that the audio signal from the tuner is always routed through U14 via the digital path.

The following are input decoupling capacitors: C164 and C165 (for DECODER SCART), C166 and C167 (for TV SCART) and C168 and C169 (for VCR SCART). The capacitor ends connected to U14 should have a DC bias of approx. 3.8 V.

### Audio Processor - Peripheral Components and Control Lines

Audio processor U14 needs various peripheral components to function correctly:

- X4, C170 and C171 (on pins 62 and 63) form the crystal oscillator circuit which runs at 18.432 MHz;
- C179, C180 (on pins 43 and 44) are filter capacitors for the SCART A/D;
- C181, C182 (on pin 42) are filter capacitors for the internal analogue voltage reference;
- C177, C178 (on pin 54) are filter capacitors for the audio baseband A/D;
- C183, C184 (on pins 40 and 38) are filter capacitors for the volume control D/A and for the AV D/A;
- C157, C156 (on pins 31 and 32) are filter capacitors for the SCART D/A;
- filter capacitors for the power supplies as follows: C175 (+5 V on pin 57), C185 (+8 V on pin 39 to 41), C148 and C149 (+5 V on pin 18 to 19), C147 (+5 V on pin 6 to 7);
- D37 and R251 form a voltage regulator to convert +14 V to 8 V at pin 39.

Control/bus links to/from the audio processor are:

- pin 9 is the I²C bus clock to pin 40 of the main control microprocessor U4;
- pin 10 is the I²C bus data which connects to pin 33 of U4;
- pin 4 is the IN/EXT_VIDEO control line to U21;
- pin 5 is the VCR/SAT control line to U20.

### Audio Baseband Processing and Signal Routing

The digital field processor in U14 and the amplifiers Q36, Q37 and Q38 process all the audio baseband signals and perform signal routing.

Digital signal processing comprises:

- input pre-processing;
- audio mode selection (Stereo A, B, C or D, Mono 1 to 9, or customised mode, as selected at the Audio Menu);
- audio mode post-processing.

All of the above processing changes depend on a combination of the following:

- the operation of the TV/SAT key (for switching between satellite and terrestrial TV - pin 8 of TV SCART);
- the activity of the DEC status - pin 8 of DECODER SCART (also controlled by the 0 (AV) key for switching between the external decoder and satellite TV).

The signals emerge from pins 28 and 29 of U14 and are amplified before going to the TV SCART, the phono outputs and the optional AV sockets (see also below). The amplifiers have a gain of 4 and consist of Q37 and associated components for the right channel and Q38 and associated components for the left channel. Capacitors C265 and C266 decouple the high frequency digital noise and C173, C174 couple the signals from the audio processor U14 to the amplifiers.

### DECODER SCART Audio Output

The audio source for the DECODER SCART output is always FM SAT (L and R) (frequency modulated satellite signal - i.e. analogue audio). Note that the DECODER SCART is an auxiliary input and a decoder output. It can be used as an audio and video input, but only the audio from the satellite signals and selected baseband video are output, so if you were to attach a VCR this SCART, you could record satellite audio, but you will only be able to record a good picture if the Decoder Output option at the External AV Menu is set to clamped.

C158, R228 (for right channel) and C159, R229 (for left channel) couple the output signals from pins 33 and 34 respectively of the audio processor U14 to the DECODER SCART connector. The signal level cannot be controlled by the volume rocker key on the satellite receiver handset.

### VCR SCART Audio Output

The audio source for the VCR SCART output can be any one of the following:

- FM SAT (L and R)
- DEC (L and R) (audio from equipment connected to the DECODER SCART).

C162, R236 (for right channel) and C163, R237 (for left) couple the signals from pins 36 and 37 respectively of the audio processor U14 to the VCR SCART.

### UHF Audio Output

The audio source for the UHF output can be any one of the following:

- FM SAT;
- VCR (audio from VCR);
- DEC.

Note that there is also provision in the hardware for audio from terrestrial TV to be the source for the UHF audio output, but this is not currently implemented in the software.

The signals going to the modulator are combined and pre-emphasised by Q36 and associated components to give a mono signal. The audio source for the modulator is always the same as that for the TV SCART. The output level can be controlled by the volume rocker key on the satellite receiver handset.

***NOTE:*** *There is no treble/bass control for the output to the UHF modulator, therefore if the TV is connected by a UHF lead, no sound shapes can be selected.*

### TV SCART Audio Output and Phono Socket Output

Any of the following audio sources can be routed to the TV SCART:

- FM SAT;
- VCR;
- DEC.

The signals to the TV SCART also pass to the right and left phono connectors SK5.

On some models additional AV phono sockets are fitted (SK6); in this case the left and right audio signals which go to the TV SCART are combined by R590 and R591 and pass to the audio socket of the AV phono sockets.

The signal level can be controlled by the volume rocker key on the satellite receiver handset.

# OSCILLOGRAMS FOR FAULT TRACING

The oscillograms which follow are divided into 5 sections: Video, Audio, SMPS, Control and VideoCrypt (including some tests that can be performed with the card reader circuitry). It is important that, within each of these sections, you check the presence of the signals in the order they are given (e.g. for the video circuitry test at points 1 to 13 in that order).

The oscillograms are numbered sequentially and the appropriate section is given above each. The oscillogram numbers are marked on the circuit diagram and the PCB component ident diagram. The oscillogram test points have been chosen to be on the more convenient side of the board (i.e. non-copper side). If possible, the other points where we suggest you make checks are also on this side of the PCB.

Alongside each oscillogram is a note of where the test point is, a brief description (including any special instructions) and notes on which components you need to check if your oscillogram is not like that shown.

**NOTE: The horizontal and vertical scales of each oscillogram are shown at the bottom. The 0 V point is shown by "1" with an arrow at the left-hand side; the trigger voltage is given at the bottom right-hand side and shown by an arrow at the extreme right of the trace. If the oscilloscope needs to be AC-coupled this fact is mentioned in the text, otherwise it is DC-coupled.**

Generally, if you suspect that an IC is not functioning, before you try to replace it you should check the following:

- that it is receiving its supply at the appropriate pin (if it is not being supplied, trace back the supply line to the PSU to find where there is a fault);
- that the IC is receiving instructions from the microprocessor U4 or port expanders via the control lines at the appropriate pins;
- that the receiver has been configured correctly at the appropriate menus (see pages 7 to 11 and also the User Manual for details).

**As stated at the top of page 33, there are several ICs within the VideoCrypt circuitry that you are not allowed to replace. If you suspect faults in this area, you must return the receiver to the Pace service centre.**

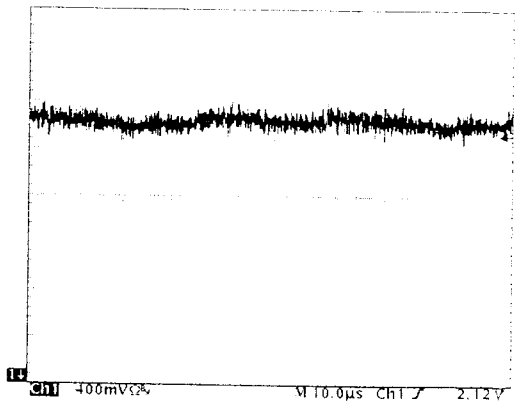
**Test Point 1:** Negative side of C238

**Description:** The trace shows tuner output (i.e. totally unfiltered video). The signal may look noisier than the trace shown if the signal is weak or the dish antenna is small.

**If the trace is not as shown, check:**

- that the tuning voltage on pin 15 of TUNER1 changes when different programmes are selected;
- the prescaler output on pin 18 of TUNER1;
- the 4 MHz reference at pin 12 of U16;
- the LNB voltage on pin 5 or pin 3 of TUNER1 (depending on whether the current programme is from LNB 1 or LNB 2 respectively).

1. VIDEO




**Test Point 2:** Positive side of C199

**Description:** Traces 2A and 2B show the normal video signal at test point 2, only the time axis is different; there may be slight variations in the trace, depending on picture content.

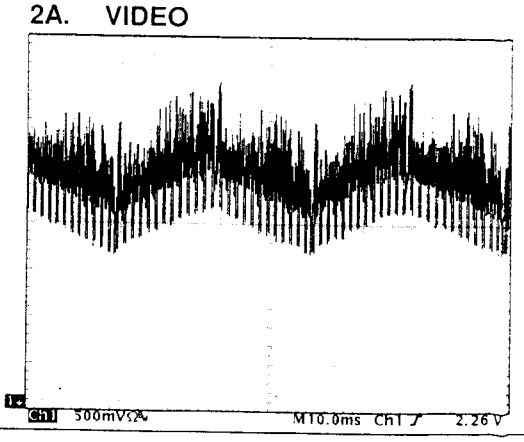
**If the trace is not as shown, check:**

- the route through U16, i.e. check back from pin 20 through to pin 3 of U16 to check that the trace is as shown. (Consult the circuit description for U16.)

Note that pin 3 of U16 is similar, in effect, to point 1 above.

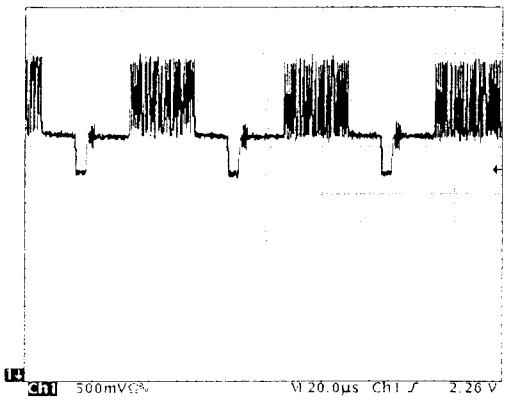
Note that pin 6 of U16 is similar, in effect, to point 1 above, but should give a trace of much larger amplitude (approx. 3 V p-p).

2A. VIDEO



**Test Point 2:** positive side of C199
(see also previous Oscillogram 2A)

2B. VIDEO



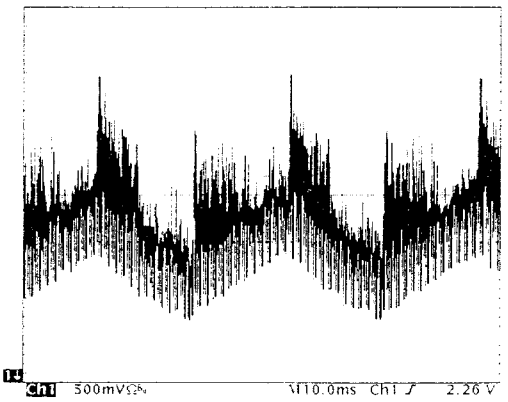

**Test Point 3:** Junction of L32 and R269 (most easily tested at the solder pad of the not fitted X7)

**Description:** The trace shows unclamped video of the correct gain. This is the video signal at one side of Q43 and C205, whereas Oscillogram 4, below, shows the signal at the other side.

**If the trace is not as shown, check:**

- Q40 and associated components;
- the gain stage (Q41, Q42).

3. VIDEO




**Test Point 4:** Junction of L33 and R272

**Description:** The trace shows clamped video at the correct DC level of 2.6 V (black level). This is the video signal at the opposite side of Q43 and C205 (compared with Oscillogram 3).

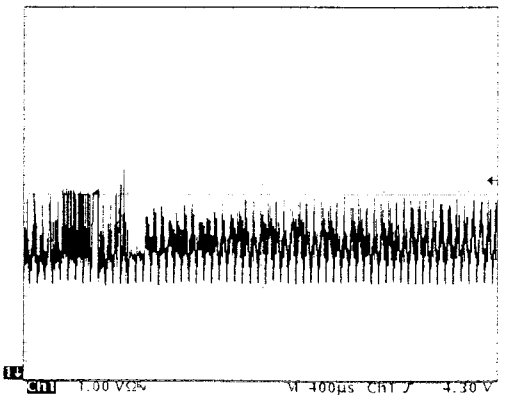
**If the trace is not at the correct DC level, check:**

- that the DC level at the base of Q45 (i.e. at the positive side of C206) is correct (2.6 V) - if it is, then Q45 and/or Q44 may be faulty.

**If the trace is not as shown, but looks like Oscillogram 3:**

- Q43, Q45 and/or Q44 may be faulty.

4. VIDEO



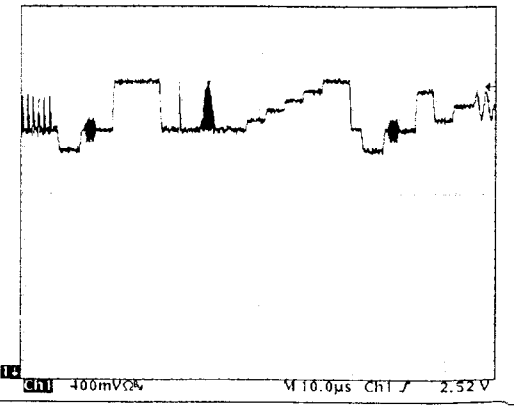

**Test Point 5:** LK237

**Description:** This trace also shows clamped video; its DC level is important - it should be approx. 2 V black level and approx. 600 mV peak-peak (sync. to bar).

**If the DC level is not correct, check:**

- Q48, Q46, Q45, Q44 and their associated circuitry.

5. VIDEO



**Test Point 6:** Negative side of C261 (same as pin 8 of U17)

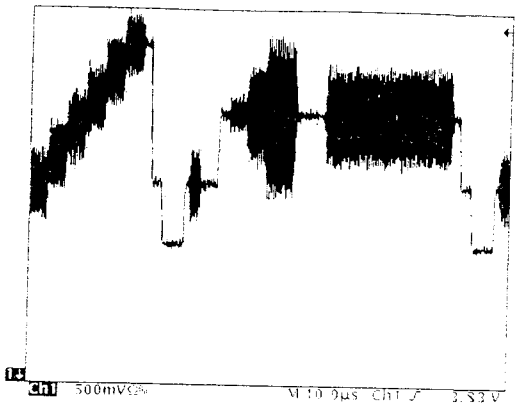
**Description:** Trace 6A shows the trace you would expect at test point 6 when there is a picture on the screen; trace 6B (next oscillogram) shows what to expect if there is a plain coloured background with graphics on the screen.

Check for trace 6A. If this is as expected, then select a plain coloured screen with graphics (e.g. Main Menu) and look for trace 6B.

**If the traces are not as shown, check:**

- that the horizontal sync is being fed into pin 18 of U17 (see oscillogram 10);
- that the vertical sync is being fed into pin 19 of U17 (see oscillogram 11).

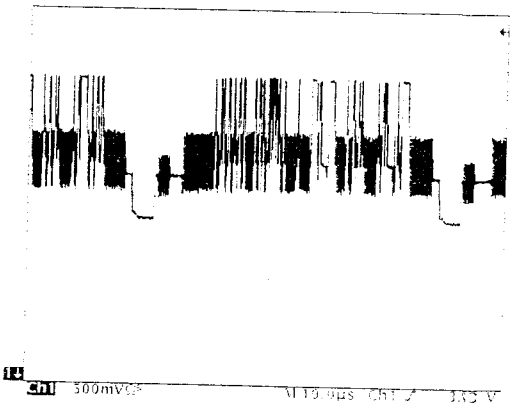
6A. VIDEO



**Test Point 6:** Negative side of C261 (same as pin 8 of U17) (see oscillogram 6A)

**Description:** Trace 6B shows what to expect at test point 6 if there is a plain coloured background with graphics on the screen. The graphics can be seen on the centre of the trace.

6B. VIDEO



**Test Point 7:** Positive side of C261

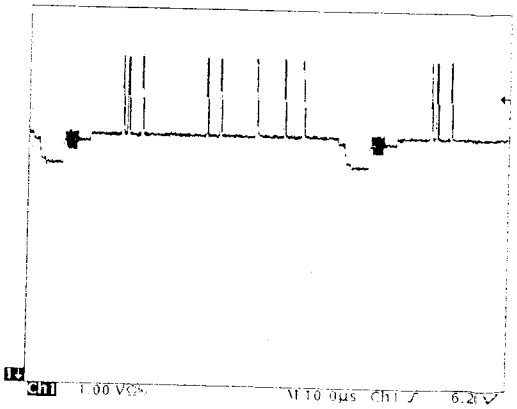
**Description:** The trace shows the sync. pulses and graphics when U17 is in "black background" mode (i.e. it is generating its own sync. pulses on a video signal from pin 8 of U17).

To set up this "black background" mode, display the Tuning Menu for the current programme, then pull out the appropriate LNB connector.

**If the trace is not as shown, check:**

- Q91, Q92, Q93, Q63 and associated components.

7. VIDEO



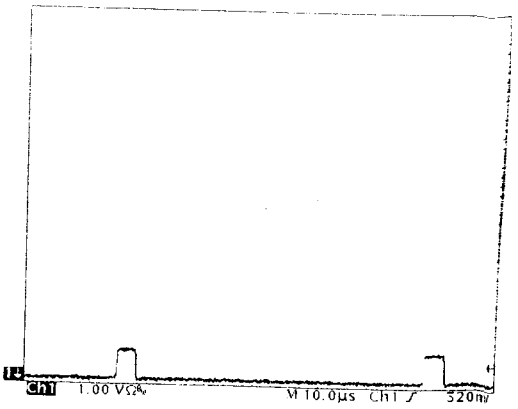
**Test Point 8:** Negative side of D58

**Description:** The trace shows the sync. pulses which have been extracted by Q91 (again when U17 is in black background mode).

**If the trace is not as shown, check:**

- Q91, D58 and associated components in the sync. extractor circuitry

8. VIDEO



**Test Point 9:** Link J8

**Description:** The trace shows the graphics on noise (again when U17 is in black background mode)

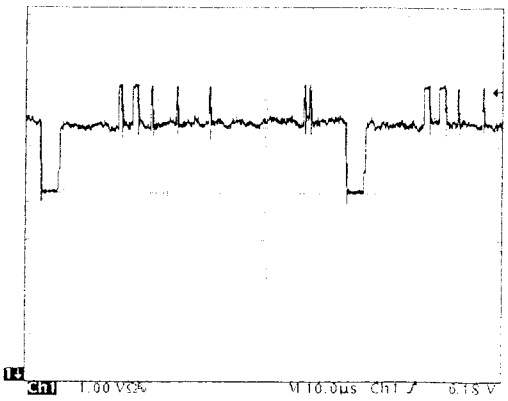
**If the trace does not show sync. pulses, check:**

- Q92, Q93, Q63 and associated components.

**If the trace does not show graphics, check:**

- Q90, Q63 and associated components.

9. VIDEO



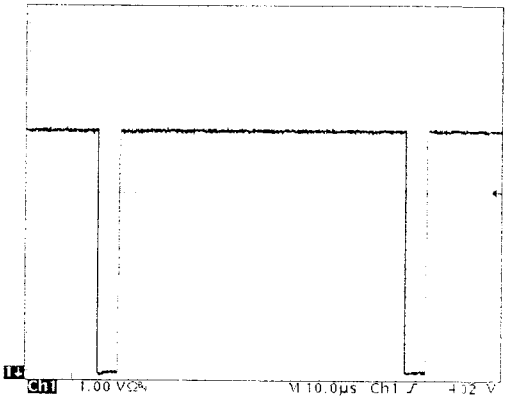
**Test Point 10:** LK178

**Description:** The trace shows the horizontal sync. as it enters pin 18 of U17.

**If the trace is not as shown, check:**

- U12, Q17 and associated components in the sync. separator circuitry

10. VIDEO



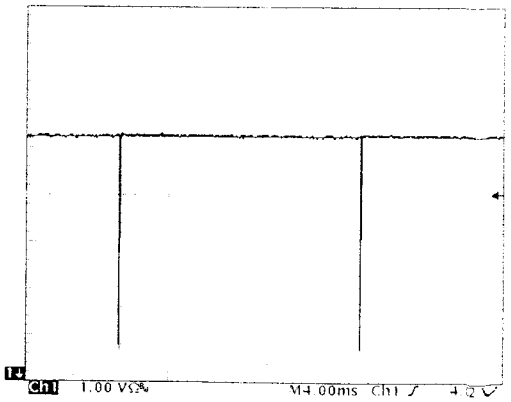
**Test Point 11:** LK177

**Description:** The trace shows the vertical sync. as it enters pin 19 of U17.

**If the trace is not as shown, check:**

- U12 and associated components in the sync. separator circuitry

11. VIDEO



**Test Point 12:** Pin 19 of SK3 (TV SCART)

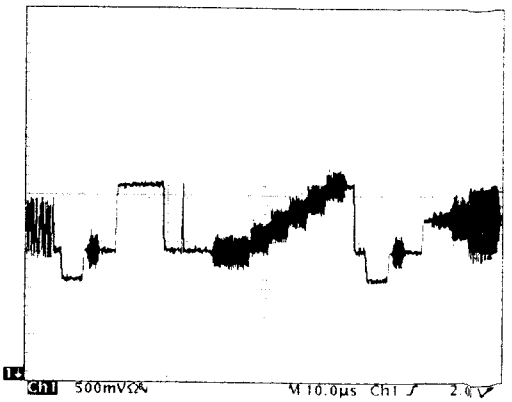
**Description:** The trace shows approx. 1 V peak-to-peak of clamped composite video (if the TV is connected to the SCART socket).

**If the trace is not as shown or has the wrong amplitude, check:**

- Q60, Q61 and associated circuitry.

Note that the video output to the TV SCART at test point 12 depends on the routing through switch U20 to pin 15 of U20. For the satellite video signal pin 1 should be switched to pin 15 (see the video circuit description on page 19).

12. VIDEO



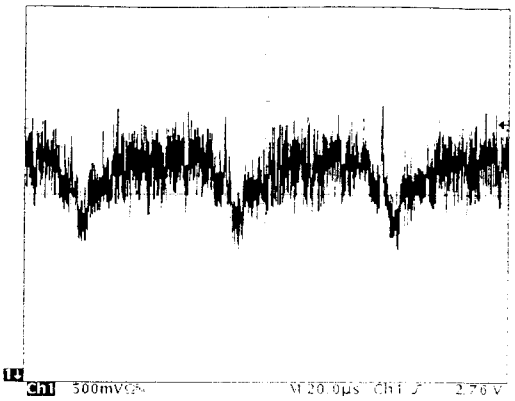
**Test Point 13:** LK249 which is the same as pin 19 of SK4 (DECODER SCART)

**Description:** The trace 13A is when PAL has been set at the "Decoder Output" option in the Decoder Menu. It shows baseband video and should be approx. 2 V peak-to-peak. See also Oscillogram 13B below.

**If the trace is not as shown or has the wrong amplitude, check:**

- U16, R303, R304, C223, C224 and the route from pin 22 of U16 (Q68, Q53, Q52 and associated circuitry).

13A. VIDEO



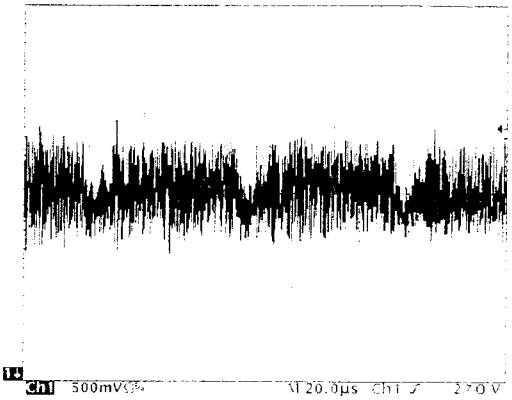

**Test Point 13:** LK249 which is the same as pin 19 of SK4 (DECODER SCART)

**Description:** The trace 13B is when MAC has been set at the "Decoder Output" option in the Decoder Menu. It shows baseband video and should be approx. 1 V peak-to-peak. See also Oscillogram 13A above.

**If the trace is not as shown or has the wrong amplitude, check:**

- U16, R305, C225 and the route from pin 22 of U16 (Q68, Q53, Q52 and associated circuitry).

13B. VIDEO




**Test Point 13:** LK249 which is the same as pin 19 of SK4 (DECODER SCART)

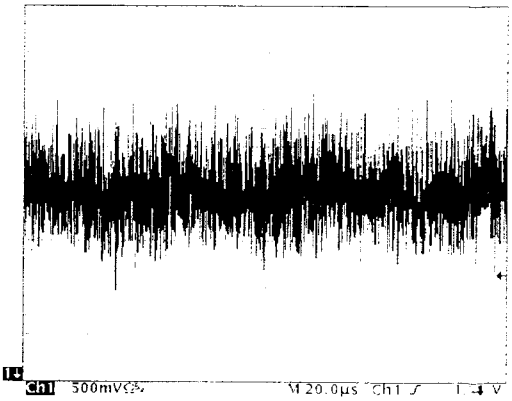
**Description:** The trace 13C is when "Flat" has been set at the "Decoder Output" option in the Decoder Menu. It shows baseband video and should be approx. 2 V peak-to-peak.

**If the trace is not as shown or has the wrong amplitude, check:**

- U16 and the route from pin 22 of U16 (Q68, Q53, Q52 and associated circuitry).

Note that when "Flat" is selected, the output from the pre-amp within U16 is switched straight through to the baseband amplifier, therefore bypassing all the de-emphasis circuitry.

13C. VIDEO



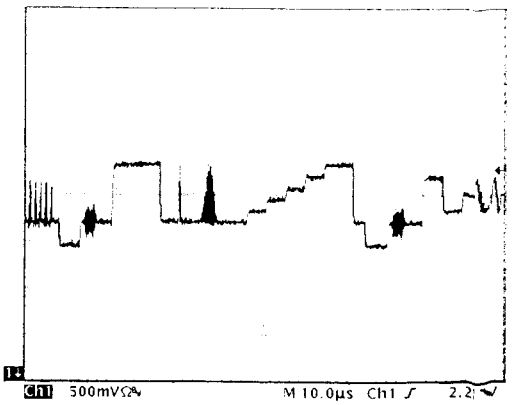

**Test Point 13:** LK249 which is the same as pin 19 of SK4 (DECODER SCART)

**Description:** The trace 13D is when "Clamped" has been set at the "Decoder Output" option in the Decoder Menu. In this case, it is NOT the output from the baseband amplifier in U16 which passes to the DECODER SCART. Instead it is the clamped video signal from the energy dispersal clamp. The trace is therefore very similar to Oscillogram 12.

**If the trace is not as shown check:**

- Q95, Q67, Q53, Q52 and associated circuitry.

13D. VIDEO



**Test Point 14:** Pin 63 of U14

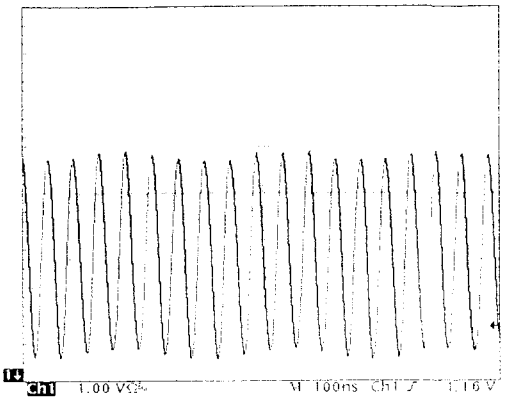
**Description:** The oscilloscope probe should be on x 10, otherwise it will load the crystal.

The trace shows the amplitude of the 18.432 MHz reference.

**If the trace is not as shown, check:**

- X4 and associated circuitry.

14. AUDIO



**Test Points 15:** Positive sides of C160 and C161 and at LK289

**Description:** AC coupled oscilloscope

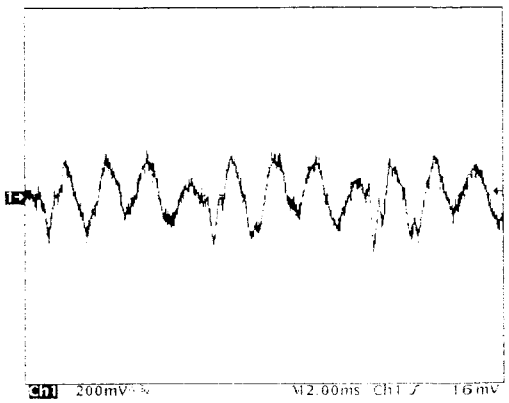
The trace should be similar at all three points. It shows the amplified audio signals for the right channel (C160) and left (C161) before they pass to the phono outputs and to the TV SCART. At LK289 the signal is the mono output to the UHF modulator (i.e. the left and right channels combined and pre-emphasised by Q36).

The signal should be biased around 0 V, so ensure that the trace is produced with 0 V at the centre of the screen.

**If the trace is not as shown, check:**

- the components and circuitry back to and including U14.

15. AUDIO



**WARNING: While you are making the following measurement, you must NOT be earthed and the oscilloscope must NOT be earthed at its mains plug. The oscilloscope probe's earth clip must be attached to the junction of R68 and C61. Do not touch any metal parts of the oscilloscope.**

**Test Point 16:** End of R51 (i.e. same as U3, pin 5)

**Description:** AC coupled oscilloscope

The frequency of the trace varies with the input voltage and the PSU load.

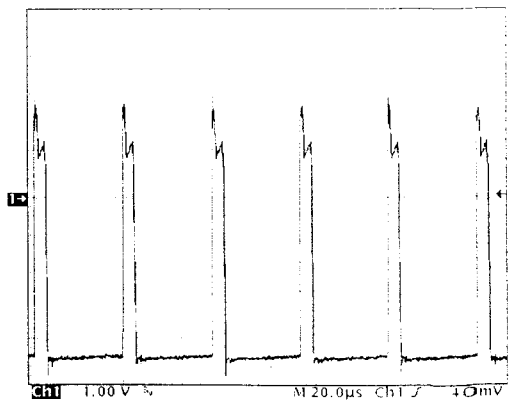
**If trace is not as shown, TURN OFF THE PSU and check:**

- the SMPS circuit; if fuse FS1 keeps blowing, check for shorts on any of the supply rails and that Q5 is not short-circuit.

**Taking heed of the WARNING above, power up the receiver again and check that:**

- the voltage at positive side of C58 (i.e. same as pin 6 of U3) charges up to approx. 6 V then drops to approx. 5.5 V - if it does not, check FS1 or suspect U3.

16. SMPS



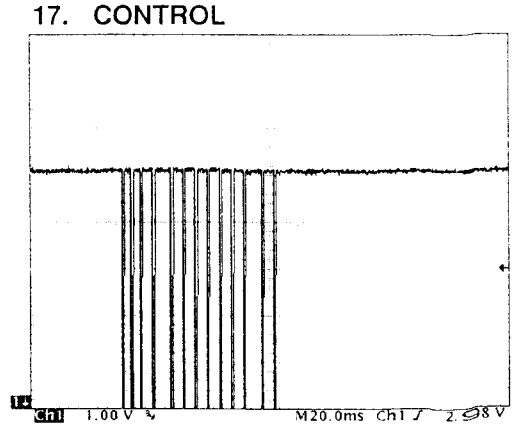
**Test Point 17:** Pin 2 of IR1

**Description:** The trace shows typical data out of the IR sensor; press keys on the handset to obtain the trace.

**If the trace is not as shown, check:**

- the handset and IR1.

17. CONTROL



**Test Point 18:** Pin 33 of U4

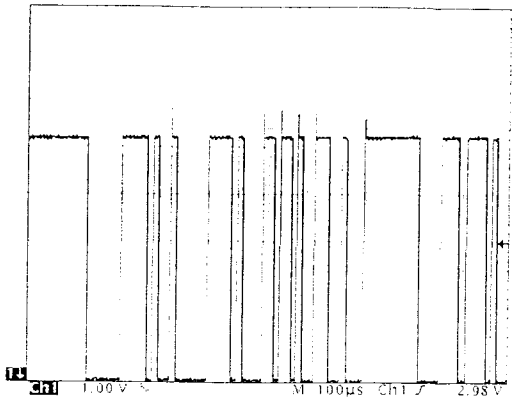
**Description:** The trace shows a typical data (DATA) signal when the handset keys are pressed to change the programme number.

Press the number keys while looking for the trace.

**If the trace is not as shown, check:**

- U4 and any of the ICs on the I²C bus or serial bus.

18. CONTROL




**Test Point 19:** Pin 29 of U4

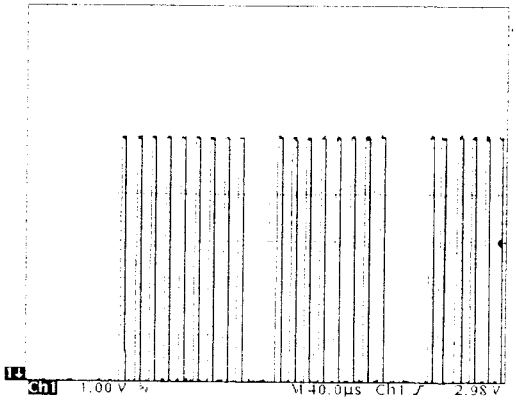
**Description:** The trace shows a typical serial clock (SERIAL_CLK) signal when the handset keys are pressed to change the programme number. The I2C_CLK line on pin 40 of U4 should be similar.

Press the number keys while looking for the trace.

**If the trace is not as shown, check:**

- U4 and any of the ICs on the serial bus (for SERIAL_CLK) or the I²C bus (for I2C_CLK).

19. CONTROL




**Test Point 20:** LK54 (i.e. pin 13 of U5 and pin 32 of U4)

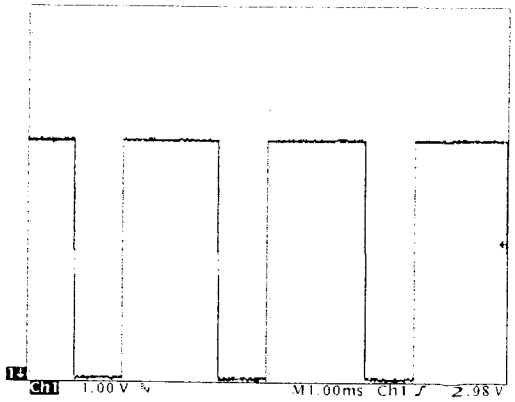
**Description:** The trace shows the functioning of U5. The signal should be logic 1 until one of the three front panel buttons ⏻, + and – (switches SW1, SW2, SW3 respectively) is pressed. When one button is pressed, the trace has a logic 0 for one third of the total period (as shown right). When two buttons are pressed, the logic 0 is for two thirds of the period and when all three buttons are pressed, the whole trace is logic 0.

If you test at pin 3 of U5 (pin 31 of U4) the trace should be similar, except the normal state is logic 0. The simplest way to test this is to short out the LNB to simulate LNB overload conditions. This should give a logic 1 for one third of the period.

**If the trace is not as shown, check:**

- U5, switches SW1, SW2, SW3 and control lines at U5.

20. CONTROL




**Test Point 21:** LK55 (i.e. pin 2 of U6 and pin 23 of U4)

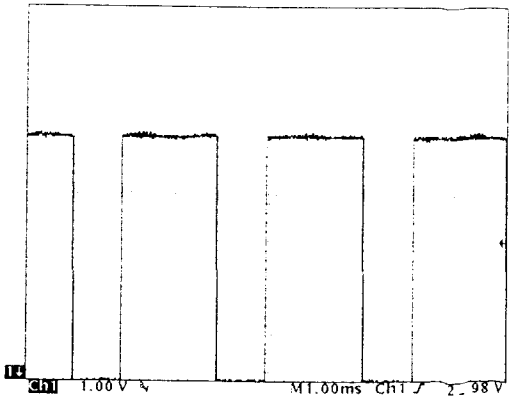
**Description:** The trace shows a typical control signal for the illumination of the segments (A to G) in the 3-character display. The ratio of time at logic 0 to the total period depends on which character is displayed (the trace right is for the character 1). The normal state is logic 1 (i.e. when nothing is displayed on the front panel, the trace will be constantly high).

See also the diagrams and table on page 23. For 1, the first two characters are not illuminated, the third is illuminated in segments B and C. Therefore the trace at pin 2 goes to logic 0 for one third of the period. Check that the traces obtained at pins 1, 2, 6 and 7 of U6 correspond with the tables on page 23 when various characters are displayed on the front panel.

**If the trace is not as shown, check:**

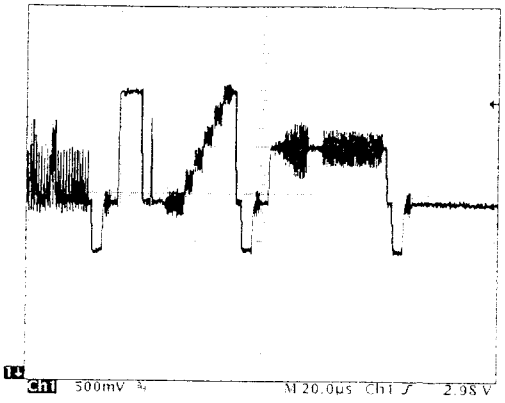
- U4, U6 and LED1.

21. CONTROL



**NOTE: In VideoCrypt fault tracing, you are not permitted to swap out ICs U8, U9, U10, U11, U12 and U13, so if you suspect a fault in these ICs you must return the receiver to the Pace service centre.**

22. VIDEOCRYPT



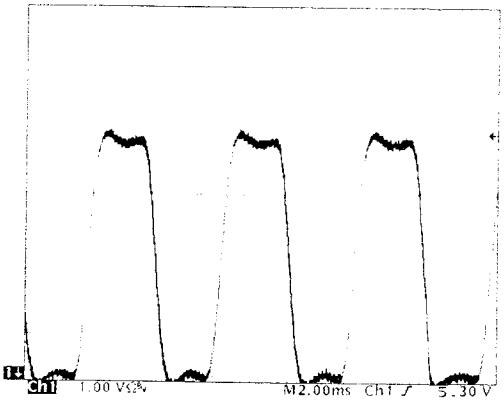

**Test Point 22:** Pin 14 of U8 (VideoCrypt circuit diagram)

**Description:** This trace shows the clamped video input to the VideoCrypt circuitry (note it is very similar to Oscillogram 5): its DC level is important - it should be approx. 2 V black level and approx. 1.85 V peak-peak (sync. to bar).

**If the DC level is not as shown, check:**

- Q94, Q46, Q45, Q44 and their associated circuitry.

23. VIDEOCRYPT



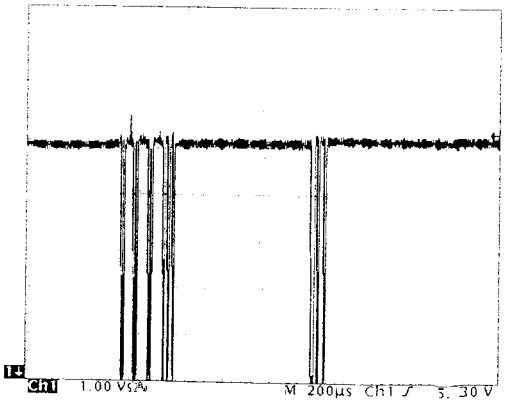

**Test Point 23:** Pin 36 of U8 (VideoCrypt circuit diagram)

**Description:** The trace shows the 7 MHz clock signal.

**If the trace is not as shown, check:**

- that X2 is oscillating at 28 MHz.

24. VIDEOCRYPT




**Test Points 24:** Pins 23, 24, 25, 26, 27, 28, 29, 30 of U8 (VideoCrypt circuit diagram)

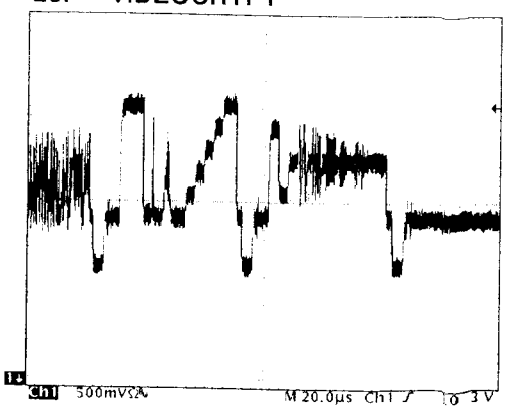
**Description:** The trace should look similar at all of the above test points, which are the data bus outputs of U8.

Check that all 8 bits of data are present (one bit is associated with each of the above pins). Check that the data has a similar appearance by testing at pins 14 to 21 respectively of U9, at pins 7 to 14 respectively of U10 and at pin 1 to 8 respectively of U11.

**If the trace is not as shown, check:**

- the appropriate IC and look for shorts or broken tracks on the data bus.

25. VIDEOCRYPT




**Test Point 25:** Pin 19 of U12 (VideoCrypt circuit diagram)

**Description:** This is the video input to the sync. separator U12. Check the DC level which should be approx. 1.8 V (black level).

**If the DC level is not 1.8 V, check:**

- that the signal is AC decoupled by C108 (by checking that the voltage is different at the other side of C108).

**If the trace is as shown, but there is still a problem, check:**

- that the ID_HSYNC line is high (5 V) at LK84; if it is not then suspect that U12 or associated components are faulty.

**Test Point 26:** Junction of L17 and X3 (VideoCrypt circuit diagram)

**Description:** The trace shows the 500 kHz clock signal.

**If the trace is not as shown, check:**

- R143 and X3

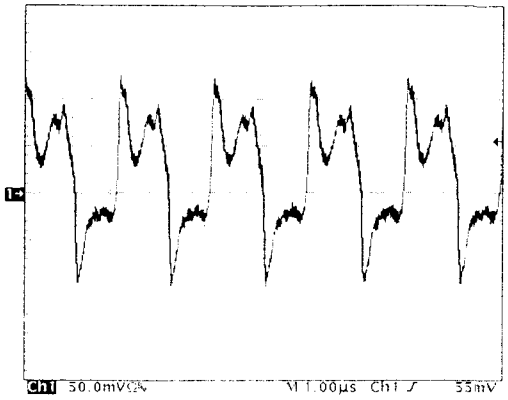
If the trace is as shown, but there is still a problem, check:

- that the reset lines (RST) are greater than 4 V at the following points: U4 pin 6 (main circuit diagram), U8 pin 20 and U10 pin 1 (VideoCrypt circuit diagram)

**If any of the above reset lines are less than 4 V, check:**

- Q7, Q8, Q9, Q10 and associated components.

26. VIDEOCRYPT




**Test Point 27:** Negative side of C216 (main circuit diagram)

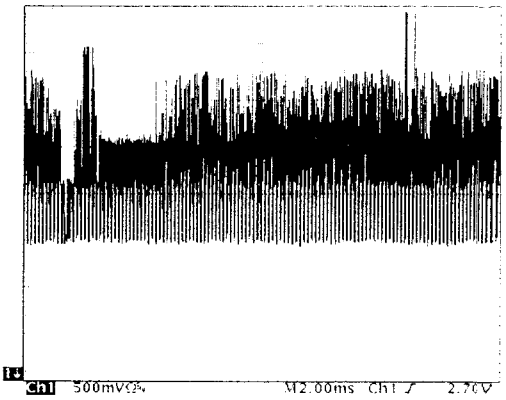
**Description:** The trace shows the video signal with a scale of 2 ms per division on the time axis. There are two areas of peaks. The first (leftmost) is the vertical sync. and VITS; the other is the graphics. Oscillogram 27B (see next oscillogram) is a larger scale version of the graphics portion of oscillogram 27A.

The test needs to be carried out when an encrypted programme has been chosen but the viewing card is not inserted (so that graphics messages appear on the screen). Note the voltage level of the inserted graphics.

**If the voltage level is not as shown on the trace, check:**

- U9, U18 (including R291, R292 and R293), Q50, Q49 and associated circuitry.

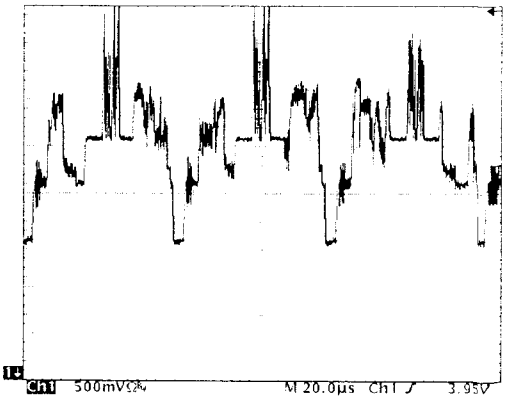
27A. VIDEOCRYPT




**Test Point 27:** Negative side of C216 (main circuit diagram)

**Description:** This is a larger scale version of the graphics portion of oscillogram 27A (see preceding oscillogram).

27B. VIDEOCRYPT



## Checks on the Card Reader

If the receiver is still showing the "CARD INVALID" message, but testing at the test points 22 to 27 has given traces as shown and you appear to have found no faulty components in the VideoCrypt circuitry, you can then carry out some further checks on the card reader circuitry as described below.

### Supply to the card reader IC:

- check that the 27 V (switched) supply is present at pin 3 of U13 and 12 V is at pin 7 of U13; if the 27 V is absent, check Q9 and Q10 (main circuit diagram) and that the reset line (at LK48 on the main circuit diagram) is high.

### Supply to the card reader:

***NOTE:*** *For the first of the two tests below we recommend that you use a* ***dummy*** *card (or a SKY card upside down), because a good, valid card could be damaged if there is a problem with the levels of VCC and VPP (which could go as high as 27 V).*

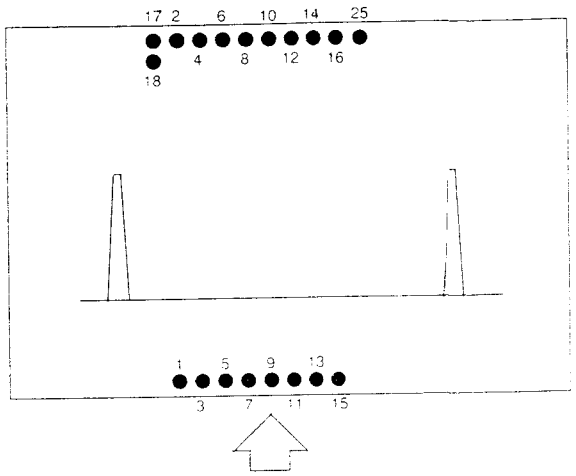
- with the **dummy card** inserted, check that VCC and VPP at pins 9 and 5 respectively of the card reader reach 5 V temporarily as the card is inserted (they do not remain at 5 V unless the card is valid); if they do not reach 5 V, check that VCC and VPP are 5 V at pins 8 and 2 respectively of U13;
- if VCC and VPP are not 5 V (or they are 5 V at U13 but there is still a problem), check the path from U13 to the card reader and also check that the card detect line (CARDDET) at pin 17 of U13 goes to 5 V when the card is inserted.

### Clock to the card reader:

- check that incoming clock is present at pin 1 of U15 and the buffered clock output (approx. 3.5 MHz) is present at pin 4 of the card reader (C3CLK line). If there is a problem the clock will be intermittent.

**If there is still a problem and the above signals are present, contact the Pace service centre.**

### Pin Numbering for Card Reader




This is the view of the pins on the **solder side** of the board (the pins are not accessible from the component side).

## GRID REFS - IDENT DIAGRAMS FOR MAIN PCB

* = not fitted
† = mounted on copper (SMD) side of PCB
^ = actually a link (in an inductor position)
° = actually a capacitor (in a resistor position)
◊ = actually a zerohm link (in a capacitor position)
∞ = actually a diode (in a link position)
§ = not fitted if there is a U4 extension PCB
A = component of different pitch could be fitted

| CAPACITORS | | C19 | D13† | C39 | C14† |
|---|---|---|---|---|---|
| | | C20 | D13† | C40 | C14† |
| C1 | C14 | C21 | D13† | C41 | D14† |
| C2 | B14† | C22 | D13† | C42 | D13† |
| C3 | B14† | C23 | D13† | C43* | D13† |
| C4 | B13† | C24 | D13† | C44 | E12† |
| C5 | B14† | C25 | D13† | C45 | E12† |
| C6 | C14† | C26 | D13† | C46 | E13† |
| C7 | C14† | C27 | C13† | C47 | E13 |
| C8 | C14† | C28 | C13† | C48 | E13 |
| C9 | B14† | C29 | C13† | C49 | E13† |
| C10 | B13† | C30 | C13† | C50 | E13† |
| C11 | B13† | C31 | D13† | C51 | D14 |
| C12 | C13† | C32 | D13† | C52 | E13 |
| C13 | C13† | C33 | C14† | C53 | B2 |
| C14* | C13† | C34 | C14† | C54 | D2 |
| C15* | B14† | C35* | D14† | C55 | E2† |
| C16 | C13† | C36 | D14† | C56 | I6 |
| C17 | C13† | C37 | D14† | C57 | F2 |
| C18 | C13† | C38 | C14† | C57A* | G2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C58 | E2 | C86§ | G6† | C116 | G8† | C145 | I6† | C174 | C7 | C203 | D10† |
| C59 | E3 | C87§ | G6† | C117 | I7 | C146* | J4† | C175 | E5† | C204 | D10† |
| C60 | D3 | C88 | K2† | C118 | G8 | C147 | E6† | C176 | E5† | C205 | D10 |
| C61 | D3 | C89 | J6 | C119 | G8† | C148 | E5 | C177 | E5† | C206 | E9 |
| C62 | G3 | C90 | B4† | C120* | G13† | C149 | E5† | C178 | D5 | C207 | E8† |
| C62A* | G3 | C91 | F9† | C121 | J7† | C150 | E4† | C179 | E5† | C208 | D7 |
| C63 | D8 | C92 | G9† | C122 | H10 | C151 | E4† | C180 | E4† | C209 | D8† |
| C64 | E2† | C93 | G9† | C123 | G9† | C152 | E4† | C181 | E4† | C210 | D8† |
| C65 | I2† | C94 | G8† | C124 | I8 | C153 | F4 | C182 | D5 | C211 | E8† |
| C66 | I2 | C95 | H9† | C125* | H10 | C154 | E4† | C183 | D4 | C212 | E8 |
| C67 | I4 | C96 | G10† | C126 | H6† | C155 | F4 | C184 | D4 | C213 | E8† |
| C68 | I2† | C97 | G9† | C127 | E8† | C156 | E4† | C185 | E4† | C214 | E8† |
| C69 | J2† | C98 | G10† | C128 | J12† | C157 | E4† | C186 | C6 | C215 | E9† |
| C70 | J2 | C99 | G10† | C129 | I11† | C158 | B10 | C187 | C6† | C216 | E9 |
| C71 | I3† | C101* | J4 | C130 | I11† | C159 | B11 | C188 | D6† | C217 | D11 |
| C72 | J2† | C102 | J8 | C131 | J12† | C160 | C7 | C189 | D6† | C218 | D11† |
| C73 | J3 | C103 | I7† | C132 | J12† | C161 | C7 | C190 | D6† | C219 | G12† |
| C74 | I3† | C104 | I7† | C133 | G12† | C162 | C5 | C191 | D7† | C221 | D10 |
| C75 | J3† | C105 | J7 | C134 | G12† | C163 | C5 | C192 | E6† | C222 | D11† |
| C76 | J3 | C106 | I8† | C135 | H4 | C164 | B11† | C193 | E6† | C223 | C11† |
| C77 | I4 | C107 | I8† | C136 | H4† | C165 | B11† | C194 | D10† | C224 | C11† |
| C78 | H5 | C108 | J8† | C137 | D12† | C166 | C6† | C195 | C10† | C225 | D10† |
| C79 | D13† | C109 | I8 | C138* | B11 | C167 | C6† | C196 | D10† | C226* | H8† |
| C80 | C10 | C110 | I8† | C139* | B12 | C168 | C5† | C197 | D10† | C227* | H8† |
| C81 | C4 | C111 | I8† | C140 | C11 | C169 | B5† | C198 | D10† | C228* | H8† |
| C82 | C10 | C112 | G8† | C141 | D12† | C170 | D6† | C199 | D9 | C229* | H8† |
| C83 | I5 | C113 | G8† | C142 | D11 | C171 | D6† | C200 | D10† | C230 | E9† |
| C84 | G5† | C114 | G8† | C143 | J8 | C172 | E6† | C201 | D10† | C231 | D9 |
| C85 | G6 | C115 | G8† | C144 | I7† | C173 | C7 | C202* | D10† | C232* | B4† |

# GRID REFS - IDENT DIAGRAMS FOR MAIN PCB (cont.)

C233 D10
C234 C8†
C235* B10†
C236 B8
C237* C11
C238 C12
C239* C11
C240 C12
C241 B6†
C242 B5†
C243 B4
C244 C4
C245 E13†
C246 F13†
C247 C4
C248 F14†
C249 J9†
C250 G6†
C252 C10
C253 D11†
C254 D11†
C255 D11†
C256 C8
C257 I6†
C258 I7†
C259 I7†
C260 H10†
C261 D8
C262 E13
C264 E4†
C265 E4†
C266 E4†
C2670 E6†
C268 C7
C269 B5†
C270 C4†
C271 B8†
C272* G12
C273* G13†
C274* G13†
C275* F13†
C276* G12
C278 D9
C279 D9†
C280* F10†
C281* B11
C282 D12†
C283 E11†
C284 I10†
C285 G7†
C286* E11
C287* E10†
C288* E10†
C289 B5
C290 B8
C291 D11†
C292 C10†
C294 C12†
C295 F13†
C296* E11†
C297* F10†
C298* F10†
C299 C10†
C300 D7†
C301 F9†
C3020 E9†
C303 C12†
C305 D12†
C306 H5†
C3070 H5†
C3080 E8†

C309 D10†
C310 H5†
C311* E11†
C312* E8†
C313 J8†
C314 G8†
C315 J9†
C316 I10†
C317 C13†

## DIODES

D1 B13†
D2 D13†
D3 C13†
D4 D2
D5 E12
D6 D2
D7 D2
D8 D2
D9 G3
D10 G2
D11 F3
D12 F3
D13 C3
D14 D3
D15 I2
D16 I2
D17 I3
D18 I3
D19* I4
D20 J8
D21 J9
D22 J8
D23 I8
D24 I8
D25 G12
D26 H13
D27 G12
D28 H13
D29 F13
D30* F13
D31 F14
D32 F14
D33 F14
D34 F14
D35 K7
D36 K7
D37 C6
D39 B10
D40 B5
D41 C9
D42 J6
D43 C9
D44 B8
D45 B3
D46 B5
D47* I2
D48 I11
D49 G12
D50 I11
D51 G12
D57* G13
D58 D9
D59 E7
D60 E7
D61 D9
D62 B6

## INDUCTORS

L1 B14
L2 B13
L3 B13
L4 C13
L5 D13
L6 D13
L7 D13
L8 C14
L9 I3
L10 J4
L11 H4
L12 J7
L13 G10
L14 G8
L15 G8
L16 E8
L17 J8
L18 G9
L19 G9
L20 D8
L21 E8
L24 D12
L25 J7
L26 I4
L27 I7
L28 D6
L29 E6
L30 D10
L31 C10
L32 E10
L33 E10
L34 E10
L35 F12
L38 E13
L39^ E13
L40 G6
L41 I8
L42 G12
L43 G9
L45* G8

## LINKS

J1 I4
J2 D5
J3 D6
J4* H7
J5 C11
J6 K7
J7 H6
J8 C8
J9* H10†
J10 H10†
J11 H10†
J12* H10†
LK10 C8
LK18 K3
LK19 K3
LK20* F10
LK21 J2
LK22 K4
LK23 J4
LK24 J4
LK25 J4
LK26 J4
LK27 J5
LK28 J5
LK29 I5
LK30 J5
LK31 J5
LK32 J5
LK33 J6
LK34 I4
LK35 I4
LK36 J6
LK37 I4
LK38 H5
LK39 H5
LK40 G4
LK41 K7
LK42 K6
LK43 J7
LK45 J6
LK46 I6
LK47 I6
LK48 I6
LK49 I6
LK50 I6
LK51 J7
LK52 J7
LK53 I7
LK54 I6
LK55 I5
LK56 I6
LK58 J7
LK59 J8
LK60 J8
LK61 J8
LK62 J9
LK63 J9
LK64 I9
LK65 I6
LK66 I6
LK67 H6
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LK82 H7
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LK84 H7
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LK87 G7
LK88 H8
LK89 G8
LK90 H7
LK91 G7
LK92 G7
LK93 G7
LK95 G7
LK96 I9
LK97 H9
LK98 H9
LK99 H9
LK100 J10
LK101 I10
LK102 H10
LK103 H9
LK104 H10
LK105 G9
LK106 G10
LK107 G10
LK108 G10
LK109 J11
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LK136 G14
LK137 G4
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LK139 F4
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LK141 F4
LK142 F4
LK143 F4
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LK146 F5
LK147 F5
LK148 F5
LK149 F5
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LK151 F6
LK152 F6
LK153 F6
LK154 F6
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LK156 F6
LK157 F6
LK158 F7
LK159 F5
LK160 F5
LK161 F6
LK162 E6
LK163 F6
LK164 F6
LK165 E6
LK166 E6
LK167 E7
LK168 F7
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LK170 F7
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LK175 F8
LK176 F8
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LK181 F9
LK183 F9
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LK186 F8
LK187 C3
LK188 D4
LK189 D4
LK190 D4
LK191 D4
LK192 D5
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LK200 D7
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LK202 C4
LK203 C4
LK204 C5
LK205 C5
LK206 C5
LK207∞C5
LK208 C5
LK209 C5
LK210 C5
LK211 C5
LK212 C7
LK213 C6
LK214∞C7
LK215 B7
LK216 B7
LK217 B7
LK218 C7
LK219 C8
LK220 B7
LK221 E7
LK222 F8
LK223 F7
LK224 F7
LK225 E7
LK226 E7
LK227 F7
LK228 E8
LK229 E8
LK230 E7
LK231 D8
LK232 D9
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LK234 D9
LK235 E9
LK236 E9
LK237 E9
LK238 D9
LK239 D9
LK240 C9
LK241 C9
LK242 C8
LK243 C9
LK244 C9
LK245 C9
LK246 C9
LK247 C9
LK248 C9
LK249 B9
LK250 B9
LK251 B9
LK252 B9
LK253 C10
LK254 B11
LK255 C11
LK256 D11
LK257 D10
LK258 H6
LK259 E10
LK260 F9
LK261 F10
LK262 F10
LK263 F10
LK264 F10
LK265 F11
LK266 F10
LK267 F11
LK268 F11
LK269 E10
LK270 E11
LK271 F11
LK272 F11
LK273 F11
LK274 F11
LK275 F11
LK276 F12
LK277 F12
LK278 E11
LK279 E11
LK280 E11
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LK282 E12
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LK291 E12
LK292 E12
LK293 E12
LK294 E12
LK295 E12
LK296 E12
LK297 D12
LK298 D12
LK299 D13
LK300 E7
LK301 E9
LK302 F10
LK303 G12

## CONNECTORS

PL1* J7
PL1A* C12
PL3* H12
PL101* H7
PL102* J4
PL103* J4
PL104* J5
PL301* B9
PL302* B7
PL304* C4
PL305* C4
PL306* C4
PL308* D7
PL309* B10
PL310* B10
PL312* B9
PL331* F9
PL334* D11
PL336* E5
PL337* E5
PL338* E6
PL339* D6
PL353* G6
PL354* I7
PL355* G5
PL360* G6
PL3013*D12
PL3310*E5
SK1 B2
SK2 B4
SK3 B7
SK4 B10
SK5 B8
SK6* B11
SK7* E10

## TRANSISTORS

Q1 B14†
Q2 C13†
Q3 E12†
Q4 E13†
Q5 G3
Q6 I4
Q7 I5†
Q8 I5†
Q9 I5†
Q10 J5
Q11 K6†
Q12 J6†
Q13 K6†
Q14 K5†
Q15 G8†
Q16 J8†
Q17 I8†
Q18 G8†
Q19* G11†
Q20 H4
Q21* F12†
Q22* F12†
Q23 D11†
Q24* F13
Q24A* F13
Q25 F13
Q25A* F13
Q26 F14†
Q27 F12†
Q28* F12†
Q29 K8†
Q30 K4
Q31 K3†
Q32 K3†
Q33 F14†
Q34 I6†
Q35 I7†
Q36 E4†
Q37 C7†
Q38 C7†
Q39 D7†
Q40 D9†
Q41 D10†
Q42 D9†
Q43 D10†
Q44 E9†
Q45 E9†
Q46 F9†
Q47 E10†
Q48 E10†
Q49 E9†
Q50 E9†
Q51 B4
Q52 C8†
Q53 B8†
Q54* C11†
Q55 C12†
Q56 C12†
Q57 C6†
Q58 C6†
Q59 C6†
Q60 B6†
Q61 B6†
Q62 B4†
Q63 C8†
Q64* C12†
Q65 J12†
Q66 C5†
Q67 C10†
Q68 C10†
Q69 C10†
Q70* B4†
Q71 D4†
Q72 G7†
Q78* K6†
Q79 E9†
Q80* H8†
Q81* H8†
Q82* H8†
Q83* H8†
Q85 G4†
Q86 G4
Q90 D8†
Q91 D8†
Q92 D9†
Q93 D9†
Q94 F9†
Q95 D10†

## RESISTORS

R1 B14†
R2 B14†
R3 B14†
R4 B14†
R5 B14†
R6 B13†
R7 B13†
R8 B14†
R9 B14†
R10 C13†
R11 C13†
R12 C13†
R13 B13†
R14 C13†
R15* B13†
R16 B13†
R17 B13†
R18 B13†
R20 D13†
R21 C13†
R22 C13†
R23 D13†
R24 C14†
R25 C14†
R26 D13†
R27 E12†
R28 E13†
R29 E13†
R30 E13†
R31 E13†
R32 C14†
R33 B14†

## GRID REFS - IDENT DIAGRAMS FOR MAIN PCB (cont.)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R34 | B14† | R105* | K5† | R178 | H4† | R249 | C7† | R320 | B9† | R391* | I6† | R475 | B11† | R566 | K4† |
| R35 | C13† | R106 | G9† | R179 | H4† | R250 | C7† | R321 | B9† | R392 | F3 | R476 | J6† | R567 | G6† |
| R36 | B13† | R107 | G8† | R180 | G4† | R251 | C6 | R322* | C11† | R393* | C5† | R477 | I5† | R568 | G6† |
| R37 | C13† | R108 | G8† | R181* | B12† | R252 | D7† | R323* | C11† | R394* | B4† | R478 | J4† | R569 | G5† |
| R38 | C14† | R109 | G8† | R182* | B12† | R253 | D7† | R324* | C11† | R395* | B4† | R479 | F9† | R571 | D8† |
| R39 | D13† | R110 | H10† | R183* | F12† | R254 | D7† | R325* | C11† | R396 | G6† | R480 | B11† | R573 | H5† |
| R40 | D13† | R111 | H10† | R184* | F12† | R255 | D6† | R326* | C11† | R399* | G14† | R481 | I12† | R577* | C7† |
| R41 | C13† | R112 | G9† | R185* | F12† | R256 | D6† | R327 | C11† | R400* | G14† | R482 | I11† | R578* | G13† |
| R42 | C9† | R113 | I10† | R186* | F12† | R257 | D7† | R328 | C12† | R401* | G14† | R483 | E11† | R579* | G13† |
| R43 | C9† | R114 | H7† | R187* | F12† | R258 | E7† | R329 | D11† | R402* | G14† | R484 | F11† | R580* | G13† |
| R44 | C13† | R115 | G10† | R188 | D12† | R259 | D10† | R330 | C12† | R403* | G14† | R485 | F11† | R581* | G13† |
| R45 | D13† | R116 | I9† | R189 | D12† | R260 | C9† | R331 | C12† | R404* | G14† | R486 | G7† | R582* | G12† |
| R46 | B6† | R117 | I9† | R190 | D12† | R261 | D10† | R332 | B6† | R405* | G14† | R488 | H12† | R583* | G13† |
| R47 | D4† | R118 | I9† | R191* | D11† | R262 | D9† | R333 | B6† | R406* | G14† | R489* | E10† | R584* | G13† |
| R48 | E12† | R119 | I9† | R192 | D12† | R263 | D9† | R334* | B6† | R407* | G13† | R490* | F11† | R585* | G12† |
| R49 | B3 | R120 | I9† | R193 | D11† | R264 | D9† | R335 | B6† | R408* | G14† | R491 | H10† | R586 | D5† |
| R50 | F2 | R121 | I9† | R194 | F13† | R265 | D10† | R336 | C6† | R409* | G11† | R492 | C12† | R588 | G8† |
| R51 | F3 | R122 | I9† | R195 | F12 | R266 | D9† | R337 | C6† | R410* | G12† | R493 | G5† | R589 | G8† |
| R52 | G3† | R123 | I9† | R196* | F12 | R267 | D9† | R338 | C7† | R411* | E10† | R494 | K5† | R590* | C7† |
| R53 | E3† | R124 | H9† | R197 | F13† | R268 | D9† | R339 | C6† | R412* | E10† | R496 | F12† | R591* | C7† |
| R54 | E3† | R125 | I10† | R198 | F14† | R269 | D10† | R340 | B6† | R413* | E11† | R497 | E8† | R592 | J5† |
| R55 | E3† | R126 | J9† | R199 | F13† | R270 | D10† | R341 | B6† | R414 | G7† | R499 | F12† | R593 | I5† |
| R56 | E3† | R127 | G10† | R200* | F13† | R271 | E10† | R342 | B6† | R415 | G7† | R500 | E10† | R594* | H7† |
| R57 | E3† | R128 | J9† | R201* | F12† | R272* | E10† | R343 | B5† | R416 | D9† | R501 | E9† | R598 | E8† |
| R58 | C3 | R129 | H9† | R202* | F12† | R273 | E9† | R344 | B5† | R421* | G11† | R502 | J8† | R599 | E8† |
| R59 | D2 | R130 | J10† | R203* | F12† | R274 | E9† | R345 | C6† | R422 | B5† | R503 | H5† | R600 | H5† |
| R60 | G2 | R131 | J10† | R204* | F12† | R275 | F9† | R346 | B6† | R423* | G13† | R504 | G5† | R601 | G9† |
| R61 | G3 | R132 | I10† | R205 | F12† | R276 | F9† | R347 | B5† | R424* | G13† | R505 | D10† | R602 | G7† |
| R62 | F3 | R133 | I10† | R206* | F12† | R277* | F9† | R348 | B3† | R425* | K6† | R506 | C6† | R603 | C10† |
| R63 | F3 | R134 | H10† | R207 | K8† | R278 | E10† | R349 | B9† | R426* | K6† | R507 | E10† | R604* | G9† |
| R64 | D3† | R135 | H9† | R208 | K8† | R279 | F9† | R350 | C4† | R427* | J7† | R509 | C8† | R605* | E9† |
| R65 | D3 | R136 | H9† | R209 | K8† | R280 | E10† | R351 | C5† | R428* | D8† | R511 | D12† | R606 | B8† |
| R66 | C3 | R137 | I10† | R210 | K7† | R281 | E10† | R352* | B5† | R429* | H8† | R512 | C10† | | |
| R67 | C3 | R138 | J7† | R211 | K4† | R282 | E9† | R353 | C4† | R430* | H8† | R514 | C10† | | |
| R68 | G3 | R139 | J7† | R212 | K4 | R283 | E9† | R354 | C4† | R431* | H8† | R515 | H6† | | |
| R69 | I4† | R140 | J7† | R213 | K3† | R284 | D8† | R355 | D8† | R432* | H8† | R518 | F7† | | |
| R70 | H4† | R141 | I8† | R214* | K3† | R285* | D8† | R356 | C8† | R433* | H8† | R519 | D9† | | |
| R71 | H5† | R142 | J8† | R215 | K3† | R286 | E8† | R357 | E14† | R434* | H8† | R521 | F9† | | |
| R72* | E5† | R143 | J8† | R216 | I6† | R287 | E9† | R358 | C4† | R435* | H8† | R522 | H10† | | |
| R73 | C14† | R144 | J8† | R217 | I7† | R288 | E9† | R359 | C4† | R436* | I9† | R523 | H13† | | |
| R74 | I5† | R145 | G8† | R218 | I6† | R289 | E9† | R360 | C4† | R437* | H8† | R526 | F13† | | |
| R75 | I5† | R146 | J8† | R219 | I7† | R290 | F9† | R361 | C4† | R438 | D10† | R527 | F13† | | |
| R76 | I5† | R147 | J8† | R220 | I6† | R291 | F7† | R362 | E9† | R439 | J6 | R528 | D8† | | |
| R77 | I5† | R148 | J8† | R221* | G14† | R292 | F6† | R363 | B9† | R440 | F13 | R529 | G5† | | |
| R78 | I5† | R149 | I8† | R222 | E4† | R293 | E6† | R364 | C9† | R441* | F13 | R530 | G8† | | |
| R79 | I5† | R150 | I8† | R223 | E4† | R294 | B3† | R365* | C12† | R442 | C4† | R531 | F5† | | |
| R80 | J5† | R151 | I10† | R224 | E4† | R295 | B4† | R366* | C12† | R443 | C4† | R532 | G5† | | |
| R81 | J5† | R154 | G9† | R225 | F4† | R296 | E11† | R367* | C12† | R444 | G7† | R533 | D8† | | |
| R82 | H6† | R155 | H8† | R226 | E4† | R297 | E11† | R368 | J12† | R445 | G5† | R534 | H5† | | |
| R83* | H13† | R156 | J8† | R227 | F4† | R298 | D11† | R369 | J12† | R446 | D9† | R535 | D8† | | |
| R84 | G11† | R157 | C4† | R228 | B11† | R299 | D11† | R370 | J12† | R447 | C11† | R536 | H8† | | |
| R85 | H6† | R158* | J4 | R229 | B11† | R300 | D11† | R371 | H6† | R448 | B10† | R539 | G6† | | |
| R86 | H5† | R159 | H8†. | R230 | B11† | R301 | D11† | R372 | D13† | R449 | E12† | R540 | D9† | | |
| R87 | J5† | R160 | J9† | R231 | B11† | R302 | D11† | R373 | B9† | R450 | C6† | R541 | D8† | | |
| R88 | K5† | R161 | G7† | R232 | B7† | R303 | D11† | R374 | C4† | R451 | C10† | R542 | C9† | | |
| R89 | K5† | R162* | G11† | R233 | B7† | R304 | C11† | R375 | B4† | R452 | K8† | R543 | C8† | | |
| R90 | K5† | R163* | G14† | R234 | C6† | R305 | C10† | R376 | B6† | R454 | E10† | R544 | G6† | | |
| R91 | K5† | R164 | I10† | R235 | B6† | R306* | E9† | R377 | B6† | R455 | G4† | R545 | D8† | | |
| R92 | K5† | R165 | J11† | R236 | B5† | R307 | B4† | R378 | C4† | R456* | G4† | R546* | J7† | | |
| R93 | K4† | R166 | H12† | R237 | B5† | R308 | B3† | R379 | E13† | R457 | G4† | R547 | G8† | | |
| R94 | K4† | R167 | H12† | R238 | B5† | R309 | C4† | R380 | C10† | R458 | G4† | R548 | G4† | | |
| R95* | K6† | R168 | H12† | R239 | B5† | R310 | E9† | R381 | C10† | R459 | G4† | R549 | G5† | | |
| R96* | J6† | R169 | H12† | R240 | B8† | R311 | C8† | R382 | C10† | R460 | G4† | R550 | D8† | | |
| R97* | K6† | R170 | H12† | R241 | B8† | R312 | B8† | R383 | C10† | R461 | C9 | R551 | D9† | | |
| R98 | K6† | R171 | H12† | R242 | C7† | R313 | B8† | R384* | C10† | R462 | D11† | R552 | G5† | | |
| R99 | J6† | R172 | H12† | R243 | C7† | R314 | C8† | R385 | C9† | R463 | E11† | R555 | I10† | | |
| R100 | J6† | R173 | H12† | R244 | C7† | R315 | C8† | R386 | E9† | R465 | D8† | R557 | E11† | | |
| R101* | K6† | R174 | H12† | R245 | C7† | R316 | B8† | R387 | F9† | R467 | G11† | R559 | F14† | | |
| R102* | J5† | R175 | H12† | R246 | C7† | R317 | B8† | R388* | F8† | R468* | J5† | R560 | H12† | | |
| R103 | C4† | R176 | H12† | R247 | C7† | R318 | B8† | R389 | F14† | R470* | J6† | R562 | K8† | | |
| R104 | K5† | R177 | H4† | R248 | C7† | R319 | B10† | R390 | H6† | R472* | J6† | R563 | I10† | | |
| | | | | | | | | | | R474 | C12† | R564 | I9† | | |

### ICS

| | |
|---|---|
| U1 | C13 |
| U2 | D14 |
| U3 | E3 |
| U4§ | H5 |
| U5 | H6† |
| U6 | J5 |
| U7 | G7 |
| U8 | G9 |
| U9 | G10 |
| U10 | I9 |
| U11 | I10 |
| U12 | I8 |
| U13 | I11 |
| U14 | E5 |
| U15 | G12† |
| U16 | D11 |
| U17 | E8 |
| U18 | E7† |
| U19* | C11† |
| U20 | C4† |
| U21 | F8† |
| U22 | G6† |
| U23* | G13 |
| U24* | E10 |
| U25* | G13 |
| U26 | G5 |
| U27* | F10 |

### MISC. COMPONENTS

| | |
|---|---|
| CARD1 | I13 |
| CARD2* | I13 |
| CARD3* | I13 |
| FS1 | B3 |
| IR1 | K3 |
| LED1 | K4 |
| LED2* | K5 |
| LED3* | K6 |
| LED4* | K6 |
| LED5* | K6 |
| MAC1* | D5 |
| MAC2* | D5 |
| MOD1 | C13 |
| REG1* | E10 |
| REG2* | F10 |
| SW1A* | K11 |
| SW1B | K8 |
| SW2 | K10 |
| SW3 | K10 |
| SW4A* | K11 |
| SW4B | K9 |
| T1 | C2 |
| T2 | H3 |
| T3◊ | C2 |
| TST1 | J10 |
| TST2* | I11 |
| TST3* | F5 |
| TST4* | H11 |
| TUNER 1 | C12 |
| W1A | C11 |
| W1B* | B6 |
| X1§ | G6 |
| X2 | G10 |
| X3 | J8 |
| X4 | D6 |
| X5 | E6 |
| X6 | E8 |
| X7◊ | D10 |

Notes: (i) T3 is a substitute transformer for T1 in some instances (different pitch)

# GRID REFS - MAIN CIRCUIT (DIAGRAM ON SEPARATE SHEET)

* = not fitted
^ = actually a link (in an inductor position)
° = actually a capacitor (in a resistor position)
◊ = actually a zerohm link (in a capacitor position)
∞ = actually a diode (in a link position)
§ = not fitted if there is a U4 extension PCB
A = component of different pitch could be fitted
NOTE: Links and zerohm resistors in the "options" circuitry are fitted, even if the receiver does not have the option.

## CAPACITORS

| | |
|---|---|
| C1 | C2 |
| C2 | C2 |
| C3 | C2 |
| C4 | C2 |
| C5 | B1 |
| C6 | C2 |
| C7 | C1 |
| C8 | C1 |
| C9 | C2 |
| C10 | C1 |
| C11 | C1 |
| C12 | C1 |
| C13 | C1 |
| C14* | C1 |
| C15* | B1 |
| C16 | C1 |
| C17 | B1 |
| C18 | B2 |
| C19 | B2 |
| C20 | B2 |
| C21 | B1 |
| C22 | B1 |
| C23 | B1 |
| C24 | B2 |
| C25 | B1 |
| C26 | B1 |
| C27 | B1 |
| C28 | B1 |
| C29 | B1 |
| C30 | B1 |
| C31 | B1 |
| C32 | B1 |
| C33 | B2 |
| C34 | B2 |
| C35* | B2 |
| C36 | B2 |
| C37 | B2 |
| C38 | B2 |
| C39 | B2 |
| C40 | B2 |
| C41 | B2 |
| C42 | B2 |
| C43* | B2 |
| C44 | B2 |
| C45 | B1 |
| C46 | B1 |
| C47 | B1 |
| C48 | B1 |
| C49 | B1 |
| C50 | B1 |
| C51 | B2 |
| C52 | B1 |
| C53 | A1 |
| C54 | A1 |
| C55 | A2 |
| C56 | C6 |
| C57 | A2 |
| C57A* | A2 |
| C58 | A2 |
| C59 | A2 |
| C60 | A2 |
| C61 | A1 |
| C62 | A1 |
| C62A* | A1 |
| C63 | D4 |
| C64 | A2 |
| C65 | A2 |
| C66 | A2 |
| C67 | A2 |
| C68 | A2 |
| C69 | A2 |
| C70 | A2 |
| C71 | A2 |
| C72 | A2 |
| C73 | A2 |
| C74 | A2 |
| C75 | A2 |
| C76 | A2 |
| C77 | A3 |
| C78 | A3 |
| C79 | B1 |
| C80 | A6 |
| C81 | C6 |
| C82 | D4 |
| C83 | A3 |
| C84 | A4 |
| C85 | A4 |
| C86§ | A4 |
| C87§ | A4 |
| C88 | B4 |
| C89 | B3 |
| C90* | B4 |
| C101* | A2 |
| C120* | B2 |
| C127 | D4 |
| C137 | D6 |
| C138* | D5 |
| C139* | D6 |
| C140 | D6 |
| C141 | D6 |
| C142 | D6 |
| C143 | C5 |
| C144 | C6 |
| C145 | C6 |
| C146* | A2 |
| C147 | B5 |
| C148 | A5 |
| C149 | A5 |
| C150 | A5 |
| C151 | A5 |
| C152 | A5 |
| C153 | A4 |
| C154 | A5 |
| C155 | A5 |
| C156 | A5 |
| C157 | A5 |
| C158 | A6 |
| C159 | A6 |
| C160 | B6 |
| C161 | B6 |
| C162 | C6 |
| C163 | C6 |
| C164 | A6 |
| C165 | A6 |
| C166 | B6 |
| C167 | B6 |
| C168 | C6 |
| C169 | C6 |
| C170 | B5 |
| C171 | B5 |
| C172 | B5 |
| C173 | B6 |
| C174 | B6 |
| C175 | B5 |
| C176 | A5 |
| C177 | A5 |
| C178 | A5 |
| C179 | A5 |
| C180 | A5 |
| C181 | A6 |
| C182 | A5 |
| C183 | A5 |
| C184 | A5 |
| C185 | A5 |
| C186 | A6 |
| C187 | A6 |
| C188 | B5 |
| C189 | B5 |
| C190 | B5 |
| C191 | B5 |
| C192 | B5 |
| C193 | B5 |
| C194 | D4 |
| C195 | D4 |
| C196 | D4 |
| C197 | D4 |
| C198 | D4 |
| C199 | D4 |
| C200 | D3 |
| C201 | D3 |
| C202* | D3 |
| C203 | D3 |
| C204 | D3 |
| C205 | D3 |
| C206 | D3 |
| C207 | D4 |
| C208 | D4 |
| C209 | D4 |
| C210 | D4 |
| C211 | D3 |
| C212 | D3 |
| C213 | D3 |
| C214 | D3 |
| C215 | D3 |
| C216 | D3 |
| C217 | D4 |
| C218 | D4 |
| C221 | D4 |
| C222 | D4 |
| C223 | D4 |
| C224 | D4 |
| C225 | D5 |
| C226* | D2 |
| C227* | D2 |
| C228* | D2 |
| C229* | D2 |
| C230 | D3 |
| C231 | D3 |
| C232* | C6 |
| C233 | D4 |
| C234 | A6 |
| C235* | A6 |
| C236 | A6 |
| C237* | D5 |
| C238 | D5 |
| C239* | D5 |
| C240 | D5 |
| C241 | B6 |
| C242 | C6 |
| C243 | B6 |
| C244 | B5 |
| C245 | C5 |
| C246 | C5 |
| C247 | C5 |
| C248 | C6 |
| C250 | A3 |
| C252 | D4 |
| C253 | D4 |
| C254 | D4 |
| C255 | D4 |
| C256 | D5 |
| C257 | C6 |
| C258 | C6 |
| C261 | C5 |
| C262 | B1 |
| C264 | A4 |
| C265 | A5 |
| C266 | A5 |
| C267◊ | B5 |
| C268 | B6 |
| C269 | B6 |
| C270 | C6 |
| C271 | A6 |
| C272* | B3 |
| C273* | B3 |
| C274* | B2 |
| C275* | B2 |
| C276* | B3 |
| C278 | D5 |
| C279 | D5 |
| C280* | B3 |
| C281* | B6 |
| C282 | D6 |
| C283 | D4 |
| C285 | A4 |
| C286* | B2 |
| C287* | B2 |
| C288* | B2 |
| C289 | B6 |
| C290 | A6 |
| C291 | D4 |
| C292 | D4 |
| C294 | D6 |
| C295 | D6 |
| C296* | B2 |
| C297* | B3 |
| C298* | B2 |
| C299 | D4 |
| C300 | D4 |
| C301 | D3 |
| C302◊ | D6 |
| C303 | D6 |
| C305 | D6 |
| C306 | A4 |
| C307◊ | B2 |
| C309 | D4 |
| C310 | A4 |
| C311* | B2 |
| C312* | D2 |
| C317 | B1 |

## DIODES

| | |
|---|---|
| D1 | C2 |
| D2 | B2 |
| D3 | B1 |
| D4 | A1 |
| D5 | B1 |
| D6 | A1 |
| D7 | A1 |
| D8 | A1 |
| D9 | A2 |
| D10 | A2 |
| D11 | A2 |
| D12 | A2 |
| D13 | A2 |
| D14 | A1 |
| D15 | A2 |
| D16 | A2 |
| D17 | A2 |
| D18 | A2 |
| D19* | A3 |
| D29 | D6 |
| D30* | D6 |
| D31 | C6 |
| D32 | C6 |
| D33 | C6 |
| D34 | C6 |
| D35 | C5 |
| D36 | C5 |
| D37 | A6 |
| D39 | A6 |
| D40 | C6 |
| D41 | A6 |
| D42 | A3 |
| D43 | A6 |
| D44 | A6 |
| D45 | B6 |
| D46 | C6 |
| D47* | A2 |
| D57* | B3 |
| D58 | D5 |
| D59 | D1 |
| D60 | D1 |
| D61 | D3 |
| D62 | B6 |

## INDUCTORS

| | |
|---|---|
| L1 | C2 |
| L2 | C2 |
| L3 | C1 |
| L4 | B1 |
| L5 | B1 |
| L6 | B2 |
| L7 | B1 |
| L8 | B2 |
| L9 | A3 |
| L10 | A2 |
| L11 | A3 |
| L12 | B3 |
| L16 | D4 |
| L20 | D4 |
| L21 | D3 |
| L24 | D6 |
| L25 | C5 |
| L26 | A2 |
| L28 | B5 |
| L29 | B5 |
| L30 | D4 |
| L31 | D4 |
| L32 | D3 |
| L33 | D3 |
| L34 | D4 |
| L35 | B1 |
| L38 | C5 |
| L39^ | C5 |
| L40 | A3 |

## LINKS

| | |
|---|---|
| J1 | A3 |
| J2 | A5 |
| J3 | A5 |
| J4* | A4 |
| J5 | D5 |
| J6 | C5 |
| J7 | A4 |
| J8 | D5 |
| LK10 | A6 |
| LK18 | C6 |
| LK19 | C6 |
| LK20* | B2 |
| LK21 | C5 |
| LK22 | A2 |
| LK23 | A1 |
| LK24 | D1 |
| LK25 | A4 |
| LK26 | D6 |
| LK27 | D1 |
| LK28 | A3 |
| LK29 | A1 |
| LK30 | A4 |
| LK31 | B3 |
| LK32 | B3 |
| LK33 | B3 |
| LK34 | A2 |
| LK35 | D1 |
| LK36 | B4 |
| LK37 | D6 |
| LK38 | D6 |
| LK39 | A4 |
| LK41 | D6 |
| LK42 | A3 |
| LK43 | D1 |
| LK45 | D1 |
| LK46 | D1 |
| LK47 | B3 |
| LK48 | A3 |
| LK49 | B1 |
| LK50 | B1 |
| LK51 | C6 |
| LK52 | A5 |
| LK53 | D1 |
| LK54 | A4 |
| LK55 | B3 |
| LK56 | B3 |
| LK58 | C6 |
| LK61 | A5 |
| LK65 | D6 |
| LK67 | A4 |
| LK68 | D6 |
| LK70 | C6 |
| LK71 | D1 |
| LK72 | A4 |
| LK73 | A4 |
| LK74 | A4 |
| LK75 | A4 |
| LK76 | C5 |
| LK78 | D1 |
| LK80 | D6 |
| LK81 | D6 |
| LK82 | D3 |
| LK83 | CC6 |
| LK85 | D1 |
| LK87 | A3 |
| LK88 | D2 |
| LK89 | C6 |
| LK92 | D1 |
| LK100 | A3 |
| LK101 | A3 |
| LK102 | C6 |
| LK104 | D5 |
| LK108 | D5 |
| LK110 | C5 |
| LK111 | A3 |
| LK121 | A3 |
| LK129 | D5 |
| LK130 | B2 |
| LK131 | A3 |
| LK132 | D5 |
| LK135 | D5 |
| LK136 | D5 |
| LK137 | A2 |
| LK138 | A2 |
| LK139 | D1 |
| LK140 | B1 |
| LK141 | D5 |
| LK142 | A1 |
| LK143 | A5 |
| LK144 | A1 |
| LK145 | A5 |
| LK146 | C5 |
| LK147 | A4 |
| LK148 | A6 |
| LK149 | A6 |
| LK150 | D6 |
| LK151 | B4 |
| LK152 | D1 |
| LK153 | D4 |
| LK154 | D5 |
| LK155 | A4 |
| LK156 | D1 |
| LK158 | A5 |
| LK159 | A4 |
| LK160 | B1 |
| LK161 | D1 |
| LK162 | D2 |
| LK163 | A6 |
| LK164 | B1 |
| LK165 | B1 |
| LK166 | C6 |
| LK167 | D2 |
| LK168 | C6 |
| LK169 | D3 |
| LK170 | A4 |
| LK171 | D2 |
| LK174 | A3 |
| LK176 | D2 |
| LK177 | D3 |
| LK178 | D3 |
| LK180 | B4 |
| LK181 | D5 |
| LK186 | B2 |
| LK187 | D5 |
| LK188 | D5 |
| LK189 | C6 |
| LK190 | C6 |
| LK191 | D3 |
| LK192 | C6 |
| LK193 | C6 |
| LK194 | A1 |
| LK195 | A5 |
| LK196 | A5 |
| LK197 | C6 |
| LK198 | B5 |
| LK199 | B4 |
| LK200 | B1 |
| LK201 | D1 |
| LK202 | C5 |
| LK203 | D1 |
| LK204 | B5 |
| LK205 | A1 |
| LK206 | D5 |
| LK207∞ | B6 |
| LK208 | B6 |
| LK209 | B6 |
| LK210 | C5 |
| LK211 | B4 |
| LK212 | D5 |
| LK213 | B4 |
| LK214∞ | A6 |
| LK215 | C5 |
| LK216 | A6 |
| LK217 | A6 |
| LK218 | B4 |
| LK219 | D1 |
| LK220 | B4 |
| LK221 | D5 |
| LK223 | D2 |
| LK224 | D3 |
| LK225 | B1 |
| LK226 | A4 |
| LK227 | D2 |
| LK229 | D2 |
| LK230 | B1 |
| LK231 | D5 |
| LK232 | D2 |
| LK233 | B4 |
| LK234 | D3 |
| LK235 | D1 |
| LK236 | D3 |
| LK237 | D2 |
| LK238 | B4 |
| LK239 | D1 |
| LK240 | B1 |
| LK241 | B4 |
| LK242 | A6 |
| LK243 | C5 |
| LK244 | D3 |
| LK245 | A6 |
| LK246 | A6 |
| LK247 | B4 |
| LK248 | D1 |
| LK249 | A6 |
| LK250 | C5 |
| LK251 | A6 |
| LK252 | A6 |
| LK253 | B4 |
| LK254 | C5 |
| LK255 | D5 |
| LK256 | D1 |
| LK257 | D4 |
| LK258 | D4 |
| LK259 | D4 |
| LK260 | A4 |
| LK261 | D1 |
| LK262 | B2 |
| LK263 | B3 |
| LK264 | B3 |
| LK265 | D4 |
| LK266 | B3 |
| LK267 | B2 |
| LK268 | D4 |
| LK269 | D1 |
| LK270 | D4 |
| LK271 | D4 |
| LK272 | A2 |
| LK273 | D1 |
| LK274 | A5 |
| LK275 | D1 |
| LK276 | C5 |
| LK277 | B1 |
| LK278 | D3 |
| LK279 | D1 |
| LK280 | D1 |
| LK281 | D6 |
| LK282 | D6 |
| LK283 | B1 |
| LK285 | D1 |
| LK286 | B4 |
| LK287 | D6 |
| LK288 | D6 |
| LK289 | B1 |
| LK290 | A4 |
| LK291 | B1 |
| LK292 | B2 |
| LK293 | B4 |
| LK294 | D5 |
| LK295 | D6 |
| LK296 | D6 |
| LK297 | B4 |
| LK298 | B4 |
| LK299 | B2 |
| LK300 | B1 |
| LK301 | B4 |
| LK302 | B2 |
| LK303 | B1 |

## CONNECTORS

| | |
|---|---|
| PL1* | D1 |
| PL1A* | D5 |
| PL101* | A3 |
| PL102* | A3 |
| PL103* | A3 |
| PL104* | A3 |
| PL301* | A6 |
| PL302* | B6 |
| PL304* | C6 |
| PL305* | C6 |
| PL306* | C6 |
| PL308* | A6 |
| PL309* | B6 |
| PL310* | A6 |
| PL312* | A6 |
| PL331* | D2 |
| PL333* | D3 |
| PL334* | D4 |
| PL336* | A5 |
| PL337* | A5 |
| PL338* | B5 |
| PL339* | B5 |
| PL353* | A4 |
| PL354* | A4 |
| PL355* | A4 |
| PL360* | A4 |
| PL3013* | D5 |
| PL3310* | A5 |
| SK1 | A1 |
| SK2 | C6 |
| SK3 | B6 |
| SK4 | A6 |

## GRID REFS - MAIN CIRCUIT DIAGRAM (cont.)

| | |
|---|---|
| SK5 | B6 |
| SK6* | B6 |
| SK7* | B2 |

### TRANSISTORS

| | |
|---|---|
| Q1 | C2 |
| Q2 | C1 |
| Q3 | B1 |
| Q4 | B1 |
| Q5 | A2 |
| Q6 | A3 |
| Q7 | A3 |
| Q8 | A3 |
| Q9 | A3 |
| Q10 | A3 |
| Q11 | B3 |
| Q12 | B3 |
| Q13 | B3 |
| Q14 | A3 |
| Q19* | B3 |
| Q21* | D6 |
| Q22* | D6 |
| Q23 | D6 |
| Q24* | D6 |
| Q24A* | D6 |
| Q25 | D6 |
| Q25A* | D6 |
| Q26 | C6 |
| Q27 | D6 |
| Q28* | D6 |
| Q29 | C5 |
| Q30 | C5 |
| Q31 | C5 |
| Q32 | C5 |
| Q33 | C6 |
| Q34 | C6 |
| Q35 | C6 |
| Q36 | A5 |
| Q37 | B6 |
| Q38 | B6 |
| Q39 | B5 |
| Q40 | D4 |
| Q41 | D3 |
| Q42 | D3 |
| Q43 | D3 |
| Q44 | D3 |
| Q45 | D3 |
| Q46 | D2 |
| Q47 | D2 |
| Q48 | D2 |
| Q49 | D3 |
| Q50 | D3 |
| Q51 | C6 |
| Q52 | A6 |
| Q53 | A6 |
| Q54* | D5 |
| Q55 | D5 |
| Q56 | D5 |
| Q57 | B6 |
| Q58 | B6 |
| Q59 | B6 |
| Q60 | B6 |
| Q61 | B6 |
| Q62 | B5 |
| Q63 | D5 |
| Q64* | D5 |
| Q66 | B5 |
| Q67 | D5 |
| Q68 | D5 |
| Q69 | D5 |
| Q70* | B4 |
| Q71 | B5 |
| Q78* | A3 |
| Q79 | D3 |
| Q80* | D2 |
| Q81* | D2 |
| Q82* | D1 |
| Q83* | D2 |
| Q85 | A6 |
| Q86 | A6 |
| Q90 | D3 |
| Q91 | D5 |
| Q92 | D5 |
| Q93 | D5 |
| Q94 | D2 |
| Q95 | D5 |

### RESISTORS

| | |
|---|---|
| R1 | C2 |
| R2 | C2 |
| R3 | C2 |
| R4 | B2 |
| R5 | B2 |
| R6 | C2 |
| R7 | C2 |
| R8 | C2 |
| R9 | C1 |
| R10 | C1 |
| R11 | C1 |
| R12 | C1 |
| R13 | B1 |
| R14 | C1 |
| R15* | C1 |
| R16 | C1 |
| R17 | B1 |
| R18 | B1 |
| R20 | B1 |
| R21 | B1 |
| R22 | B1 |
| R23 | B1 |
| R24 | B2 |
| R25 | B2 |
| R26 | B1 |
| R27 | B1 |
| R28 | B1 |
| R29 | B1 |
| R30 | B1 |
| R31 | B1 |
| R32 | C2 |
| R33 | C1 |
| R34 | C1 |
| R35 | C1 |
| R36 | C1 |
| R37 | B1 |
| R38 | B1 |
| R39 | B1 |
| R40 | B1 |
| R41 | B1 |
| R44 | B1 |
| R45 | B1 |
| R46 | B6 |
| R47 | B5 |
| R48 | B1 |
| R49 | A1 |
| R50 | A2 |
| R51 | A2 |
| R52 | A2 |
| R53 | A2 |
| R54 | A2 |
| R55 | A2 |
| R56 | A2 |
| R57 | A2 |
| R58 | A1 |
| R59 | A2 |
| R60 | A2 |
| R61 | A2 |
| R62 | A2 |
| R63 | A2 |
| R64 | A2 |
| R65 | A2 |
| R66 | A2 |
| R67 | A2 |
| R68 | A1 |
| R69 | A3 |
| R70 | A3 |
| R71 | A3 |
| R72* | B5 |
| R73 | B2 |
| R74 | A3 |
| R75 | A3 |
| R76 | A3 |
| R77 | A3 |
| R78 | A3 |
| R79 | A3 |
| R80 | A3 |
| R81 | A3 |
| R82 | A4 |
| R84 | A4 |
| R85 | A4 |
| R86 | B4 |
| R87 | A3 |
| R88 | A3 |
| R89 | A3 |
| R90 | A3 |
| R91 | A3 |
| R92 | A3 |
| R93 | A3 |
| R94 | A3 |
| R95* | A3 |
| R96* | A3 |
| R97* | A3 |
| R98 | B3 |
| R99 | B3 |
| R100 | B3 |
| R101* | B3 |
| R102* | B3 |
| R103 | C5 |
| R104 | A3 |
| R105* | A3 |
| R157 | C6 |
| R158* | A2 |
| R162* | B2 |
| R163* | B2 |
| R181* | D6 |
| R182* | D5 |
| R183* | D6 |
| R184* | D6 |
| R185* | D6 |
| R186* | D6 |
| R187* | D6 |
| R188 | D6 |
| R189 | D6 |
| R190 | D6 |
| R191° | D6 |
| R192 | D6 |
| R193 | D6 |
| R194 | D6 |
| R195 | D6 |
| R196* | D6 |
| R197 | D6 |
| R198 | C6 |
| R199 | D6 |
| R200* | D6 |
| R201* | D6 |
| R202* | D6 |
| R203* | D6 |
| R204* | D6 |
| R205 | D6 |
| R206* | D6 |
| R207 | C5 |
| R208 | C5 |
| R209 | C5 |
| R210 | C5 |
| R211 | C5 |
| R212 | C5 |
| R213 | C5 |
| R214* | C5 |
| R215 | C5 |
| R216 | C6 |
| R217 | C6 |
| R218 | C6 |
| R219 | C6 |
| R220 | C6 |
| R221* | B2 |
| R222 | A5 |
| R223 | A5 |
| R224 | A5 |
| R225 | A5 |
| R226 | A5 |
| R227 | A5 |
| R228 | A6 |
| R229 | A6 |
| R230 | A6 |
| R231 | A6 |
| R232 | B6 |
| R233 | B6 |
| R234 | B6 |
| R235 | B6 |
| R236 | C6 |
| R237 | C6 |
| R238 | C6 |
| R239 | C6 |
| R240 | B6 |
| R241 | B6 |
| R242 | B6 |
| R243 | B6 |
| R244 | B6 |
| R245 | B6 |
| R246 | B6 |
| R247 | B6 |
| R248 | B6 |
| R249 | B6 |
| R250 | B6 |
| R251 | A6 |
| R252 | B5 |
| R253 | B5 |
| R254 | B5 |
| R255 | B5 |
| R256 | B5 |
| R257 | B5 |
| R258 | B5 |
| R259 | D4 |
| R260 | D4 |
| R261 | D4 |
| R262 | D4 |
| R263 | D4 |
| R264 | D3 |
| R265 | D3 |
| R266 | D3 |
| R267 | D3 |
| R268 | D3 |
| R269 | D3 |
| R270 | D3 |
| R271 | D3 |
| R272* | D3 |
| R273 | D3 |
| R274 | D3 |
| R275 | D3 |
| R276 | D3 |
| R277* | D3 |
| R278 | D2 |
| R279 | D2 |
| R280 | D2 |
| R281 | D2 |
| R282 | D2 |
| R283 | D2 |
| R284 | D4 |
| R285* | D4 |
| R286 | D3 |
| R287 | D3 |
| R288 | D3 |
| R289 | D3 |
| R290 | D3 |
| R291 | D1 |
| R292 | D2 |
| R293 | D2 |
| R294 | B6 |
| R295 | C6 |
| R296 | D4 |
| R297 | D4 |
| R298 | D4 |
| R299 | D4 |
| R300 | D5 |
| R301 | D4 |
| R302 | D4 |
| R303 | D5 |
| R304 | D4 |
| R305 | D5 |
| R306* | D3 |
| R307 | C6 |
| R308 | C6 |
| R309 | C6 |
| R310 | D3 |
| R311 | A6 |
| R312 | A6 |
| R313 | A6 |
| R314 | A6 |
| R315 | A6 |
| R316 | A6 |
| R317 | A6 |
| R318 | A6 |
| R319 | A6 |
| R320 | A6 |
| R321 | A6 |
| R322* | D5 |
| R323* | D5 |
| R324* | D5 |
| R325* | D5 |
| R326* | D5 |
| R327 | D5 |
| R328 | D5 |
| R329 | D5 |
| R330 | D5 |
| R331 | D5 |
| R332 | B6 |
| R333 | B6 |
| R334* | B6 |
| R335 | B6 |
| R336 | B6 |
| R337 | B6 |
| R338 | B6 |
| R339 | B6 |
| R340 | B6 |
| R341 | B6 |
| R342 | B6 |
| R343 | B6 |
| R344 | B6 |
| R345 | B6 |
| R346 | B6 |
| R347 | C6 |
| R348 | B6 |
| R349 | A6 |
| R350 | C5 |
| R351 | B5 |
| R352* | B5 |
| R353 | B5 |
| R354 | B5 |
| R355 | D5 |
| R356 | D5 |
| R357 | C5 |
| R358 | C5 |
| R359 | C5 |
| R360 | C5 |
| R361 | C5 |
| R362 | D2 |
| R363 | A6 |
| R364 | A6 |
| R365* | D5 |
| R366* | D5 |
| R367* | D5 |
| R371 | A4 |
| R372 | B1 |
| R373 | A6 |
| R374 | C6 |
| R375 | C6 |
| R376 | B5 |
| R377 | B5 |
| R378 | B5 |
| R379 | C5 |
| R380 | D5 |
| R381 | D4 |
| R382 | D5 |
| R383 | D4 |
| R384* | D4 |
| R385 | D4 |
| R386 | D3 |
| R387 | D3 |
| R388* | D2 |
| R389 | C6 |
| R390 | C6 |
| R391* | C6 |
| R392 | A2 |
| R393* | B4 |
| R394* | B4 |
| R395* | B4 |
| R396 | A3 |
| R399* | B2 |
| R400* | B2 |
| R401* | B2 |
| R402* | B2 |
| R403* | B2 |
| R404* | B2 |
| R405* | B2 |
| R406* | B2 |
| R407* | A2 |
| R408* | A2 |
| R409* | B3 |
| R410* | B3 |
| R411* | B2 |
| R412* | B2 |
| R413* | B2 |
| R415 | D4 |
| R416 | D1 |
| R421* | B3 |
| R422 | C6 |
| R423* | B3 |
| R424* | B3 |
| R425* | A3 |
| R426* | B3 |
| R427* | A3 |
| R428* | D2 |
| R429* | D2 |
| R430* | D2 |
| R431* | D2 |
| R432* | D2 |
| R433* | D2 |
| R434* | D2 |
| R435* | D2 |
| R436* | D1 |
| R437* | D2 |
| R438 | D4 |
| R439 | A3 |
| R440 | D6 |
| R441* | D6 |
| R442 | C6 |
| R443 | C6 |
| R444 | A4 |
| R445 | A3 |
| R446 | D3 |
| R447 | D5 |
| R448 | A6 |
| R449 | C5 |
| R450 | A1 |
| R451 | D6 |
| R452 | C5 |
| R454 | D4 |
| R455 | A6 |
| R456* | A6 |
| R457 | A6 |
| R458 | A6 |
| R459 | A6 |
| R460 | A6 |
| R461 | A6 |
| R462 | D4 |
| R463 | D4 |
| R465 | D5 |
| R468* | B3 |
| R470* | B3 |
| R472* | B3 |
| R474 | D5 |
| R475 | B6 |
| R476 | B4 |
| R477 | D6 |
| R478 | B4 |
| R479 | D6 |
| R480 | D6 |
| R483 | D4 |
| R484 | A2 |
| R485 | D1 |
| R486 | A3 |
| R489* | B3 |
| R490* | B3 |
| R492 | D5 |
| R493 | A4 |
| R494 | A3 |
| R496 | D6 |
| R497 | D2 |
| R499 | A1 |
| R500 | D1 |
| R501 | D2 |
| R502 | C6 |
| R503 | A4 |
| R504 | B4 |
| R505 | D5 |
| R506 | D1 |
| R507 | D4 |
| R509 | D1 |
| R511 | D6 |
| R512 | D1 |
| R514 | D6 |
| R515 | A4 |
| R518 | B1 |
| R519 | D4 |
| R521 | D2 |
| R523 | B2 |
| R526 | D6 |
| R527 | D6 |
| R528 | D3 |
| R529 | A5 |
| R531 | B6 |
| R532 | A3 |
| R533 | D5 |
| R534 | D1 |
| R535 | D3 |
| R539 | D1 |
| R540 | D5 |
| R541 | D5 |
| R542 | D5 |
| R543 | D5 |
| R544 | A4 |
| R545 | D5 |
| R546* | B4 |
| R548 | A3 |
| R549 | B2 |
| R550 | D5 |
| R551 | D5 |
| R552 | B4 |
| R557 | D6 |
| R559 | A4 |
| R562 | B4 |
| R566 | A4 |
| R567 | A3 |
| R568 | D1 |
| R571 | D4 |
| R573 | A4 |
| R577* | B6 |
| R578* | B3 |
| R579* | B3 |
| R580* | B3 |
| R581* | B3 |
| R582* | B3 |
| R583* | B2 |
| R584* | B2 |
| R585* | B2 |
| R586 | C5 |
| R589 | C6 |
| R590* | B6 |
| R591* | B6 |
| R592 | A4 |
| R593 | A4 |
| R594* | A4 |
| R598 | D3 |
| R599 | D3 |
| R600 | A4 |
| R603 | D5 |
| R605* | D3 |
| R606 | A6 |

### ICS

| | |
|---|---|
| U1 | B2 |
| U2 | B2 |
| U3 | A2 |
| U4§ | A4 |
| U5 | A4 |
| U6 | A3 |
| U7 | A4 |
| U14 | B5 |
| U16 | D4 |
| U17 | D4 |
| U18 | D2 |
| U19A* | D5 |
| U19B* | D5 |
| U19C* | D5 |
| U20 | C5 |
| U21A | D2 |
| U22A | A3 |
| U22B | A3 |
| U23* | B2 |
| U24A* | B2 |
| U24B* | B3 |
| U25* | B3 |
| U26 | B2 |
| U27* | B2 |

### MISC. COMPONENTS

| | |
|---|---|
| FS1 | A1 |
| IR1 | B4 |
| LED1 | A3 |
| LED2* | A3 |
| LED3* | A3 |
| LED4* | A3 |
| LED5* | A3 |
| MAC1* | A5 |
| MAC2* | A5 |
| MOD1 | C1 |
| REG1* | B2 |
| REG2* | B2 |
| SW1A* | B4 |
| SW1B | B4 |
| SW2 | B4 |
| SW3 | B4 |
| SW4A* | A5 |
| SW4B | B4 |
| T1 | A1 |
| T2 | A2 |
| T3* | A1 |
| TST3* | D6 |
| TUNER1 | D6 |
| W1A | D4 |
| W1B* | B6 |
| X1§ | A4 |
| X4 | B5 |
| X5 | B5 |
| X6 | D3 |
| X7* | D3 |

## INTERCONNECTIONS

**NOTE:** Grid refs preceded by V are on the VideoCrypt circuit diagram.

| | |
|---|---|
| +27VSW | A3, VD2 |
| 27/36 | D5, D5 |
| 16-INHIBIT | B2, B5 |
| AUDIO I/F | B5, D5 |
| AUDIO_MOD | A5, B1 |
| AUTH_SWITCH | B5, VB3 |
| BANDWIDTH | A4, D5 |
| BLOCK | D2, VB5 |
| CARDDETI/P | A4, VD2 |
| CARDSEL | B2, VD2 |
| CBAND | D3, D5 |
| CE_GRAPHICS | A4, D4 |
| CE_NICKY | A4, D4 |
| CHAR | D1, VB5 |
| CLAMPED | D2, D5 |
| CLAMPED_DEC_VID | D3, D4 |
| CLMP_REF | D2, VC5 |
| DATA | A3, A4, A5, B2, B2, D4 |
| DEC_STAT | A4, A6 |
| DISH_POS | A4, A6 |
| EXT_DEC | A6, D2, VC5 |
| GR_ON_NOISE | D3, D5 |
| GRUNDIG | B4, C6 |
| HSYNC | D2, D3, VB6 |
| H/V | A4, C5 |
| I2C_CLK | A3, B5 |
| ID_HSYNC | B4, VA4 |
| INT/EXT VIDEO | B5, D3 |
| IRTE_CE | A4, B2 |
| LNB_1/2 | D3, D6 |
| LNB_OFF | A2, D6 |
| LNB_OVERLOAD | A5, C5 |
| LNB_VOLTS | C5, D6 |
| MOD_IN | B2, D5 |
| MOD_OUT | B1, D5 |
| MOD_VID | B2, C5 |
| OSC_4MHZ | A3, D4 |
| PORTCE | A4, B2 |
| REL_DRV | A2, A6 |
| RST | A3, A3, A5, D1, VC4, VC5 |
| SERIAL_CLK | A3, B2, B2, D4 |
| STBY | A3, B2 |
| TONE | A4, C6 |
| TUNER_AFC | A4, D5 |
| TV16 | B6, C5 |
| TV_STAT | B2, B6 |
| TVVID | B6, C5 |
| VCI/P | D2, VC5 |
| VC_OUT | D1, VC6 |
| VCR/SAT | B5, B5 |
| VC_RST | A4, VB3 |
| VCR_STAT | A5, C6 |
| VCR_VID | C6, D3, D5 |
| VC_STATUS | A5, D3, VB6 |
| VFD_CLK | A3, A3, D1 |
| VFD_FILAMENT | C6, D1 |
| VFD_INT | B4, D1 |
| VFD/MAC_DATA | A4, D1 |
| VSY | D1, D3, VB6, VC4 |

# SPARES - ELECTRICAL PARTS LIST FOR MAIN BOARD

**NOTE:** ⚠ indicates a safety-critical component; these must only be replaced by components of the correct type as listed in these parts lists.

## Capacitors

| | | |
|---|---|---|
| C1 | 100UF 35V 5MM RADIAL ELECT' CAP | 155-1073751 |
| C2 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C3 | SMD 33PF 50V 5% CER COG CAP 0805 (TRS) | 950-3305501 |
| C4 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C5 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C6 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C7 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C8 | SMD 18PF 50V 5% CER COG CAP 0805 (TRS) | 950-1805501 |
| C9 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C10 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C11 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C12 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C13 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C16 | SMD 22NF 50V 10% CER X7R CAP 0805 (TRS) | 950-2235621 |
| C17 | SMD 4.7PF 50V +-0.25PF CER COG CAP 0805 | 950-0475301 |
| C18 | SMD 4.7PF 50V +-0.25PF CER COG CAP 0805 | 950-0475301 |
| C19 | SMD 1.5PF 50V +-0.25PF CER COG CAP 0805 | 950-0155301 |
| C20 | SMD 1.5PF 50V +-0.25PF CER COG CAP 0805 | 950-0155301 |
| C21 | SMD 1.5PF 50V +-0.25PF CER COG CAP 0805 | 950-0155301 |
| C22 | SMD 1.5PF 50V +-0.25PF CER COG CAP 0805 | 950-0155301 |
| C23 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C24 | SMD 100PF 50V 5% CER COG CAP 0805 (TRS) | 950-1015501 |
| C25 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C26 | SMD 22NF 50V 10% CER X7R CAP 0805 (TRS) | 950-2235621 |
| C27 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C28 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C29 | SMD 150PF 50V 5% CER COG CAP 0805 (TRS) | 950-1515501 |
| C30 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C31 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C32 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C33 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C34 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C36 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C37 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C38 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C39 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C40 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C41 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C42 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C44 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C45 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C46 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C47 | 1UF 35V 5MM RADIAL ELECT' CAP TR | 155-1053751 |
| C48 | 4.7UF 35V 5MM RADIAL ELECT' CAP TR | 155-4753751 |
| C49 | SMD 22NF 50V 10% CER X7R CAP 0805 (TRS) | 950-2235621 |
| C50 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C51 | 100NF 50V 5MM M/LAYER CER.CAP TR | 157-1045751 |
| C52 | 10UF 50V 5MM 20% RAD ELEC' CAP TR | 155-1065751 |
| C53 | CLASS X CAP-100NF 250V 20% | 159-1048780 |
| C54 | 47UF 400V 7.5/10MM RADIAL ELECT CAP | 155-4769780 |
| C55 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C56 | 1000UF 25V 5MM RADIAL ELECT' CAP TR | 155-1082751 |
| C57 | CER CAP 1NF 2KV 7.5MM 10% HR SERIES TR | 159-1029651 |
| C58 | 1000UF 25V DJ3 RADIAL ELECT CAP 5MM TR | 855-1082951 |
| C59 | 22UF 35V 20% 5MM 105DEG RAD ELEC CAP | 855-2263751 |
| C60 | 10UF 35V 20% 105DEG RADIAL ELECT' CAP TR | 855-1063751 |
| C61 | 10UF 35V 20% 105DEG RADIAL ELECT' CAP TR | 855-1063751 |
| C62 ⚠ | "A" CLASS Y CAP-1NF 250V 20% (TDK-MUR) | 159-1028781 |
| C63 | 1UF 16V 5MM RADIAL ELECT' CAP TR | 155-1051751 |
| C64 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C65 | SMD 47NF 50V 10% CER X7R CAP 0805 (TRS) | 950-4735621 |
| C66 | 220UF 50V 20% 5MM 105DEG 10MM DIA CAP TR | 855-2275751 |
| C67 | 10UF 50V 5MM 20% RAD ELEC' CAP TR | 155-1065751 |
| C68 | SMD 330PF 50V 10% CER COG CAP 0805 (TRS) | 950-3315601 |
| C69 | SMD 220NF 50V 20/80% CER Y5V CAP 0805 | 950-2245951 |
| C70 | 1000UF 35V DJ3 RADIAL ELECT CAP 5MM TR | 855-1083951 |
| C71 | SMD 330PF 50V 10% CER COG CAP 0805 (TRS) | 950-3315601 |
| C72 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C73 | 1000UF 25V DJ3 RADIAL ELECT CAP 5MM TR | 855-1082951 |
| C74 | SMD 330PF 50V 10% CER COG CAP 0805 (TRS) | 950-3315601 |
| C75 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C76 | 2200UF 16V DJ3 5MM RADIAL ELECT' CAP | 855-2281950 |
| C77 | 10UF 25V 5MM RADIAL ELECT' CAP TR | 155-1062751 |
| C78 | 470UF 16V 5MM RADIAL ELECT' CAP TR | 155-4771751 |
| C79 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C80 | 10UF 50V 5MM MINI BIPOLAR RAD ELEC' TR | 156-1065752 |
| C81 | 10UF 35V 5MM RADIAL ELECT' CAP TR | 155-1063751 |
| C82 | 10UF 50V 5MM MINI BIPOLAR RAD ELEC' TR | 156-1065752 |
| C83 | 10UF 35V 5MM RADIAL ELECT' CAP TR | 155-1063751 |
| C84 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C85 | 220UF 16V 5MM RADIAL ELECT' CAP TR | 155-2271751 |
| C88 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C89 | 1000UF 25V DJ3 RADIAL ELECT CAP 5MM TR | 855-1082951 |
| C91 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C92 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C93 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C94 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C95 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C96 | SMD 39PF 50V 5% CER COG CAP 0805 (TRS) | 950-3905501 |
| C97 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C98 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| C99 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C102 | 10UF 35V 5MM RADIAL ELECT' CAP TR | 155-1063751 |
| C103 | SMD 4.7NF 50V 10% CER X7R CAP 0805 (TRS) | 950-4725621 |
| C104 | SMD 33NF 25V 10% CER X7R CAP 0805 (TRS) | 950-3332621 |
| C105 | 4.7UF 35V 5MM RADIAL ELECT' CAP TR | 155-4753751 |
| C106 | SMD 3.3NF 50V 5% CER X7R CAP 0805 (TRS) | 950-3325521 |
| C107 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C108 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C109 | 1UF 16V 5MM RADIAL ELECT' CAP TR | 155-1051751 |
| C110 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C111 | SMD 100PF 50V 5% CER COG CAP 0805 (TRS) | 950-1015501 |
| C112 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C113 | SMD 5.6PF 50V +-0.25PF CER COG CAP 0805 | 950-0565301 |
| C114 | SMD 68PF 50V 5% CER COG CAP 0805 (TRS) | 950-6805501 |
| C115 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C116 | SMD 27PF 50V 5% CER COG CAP 0805 (TRS) | 950-2705501 |
| C117 | 100UF 25V 5MM RADIAL ELECT' CAP TR | 155-1072751 |
| C118 | 22UF 16V 5MM RADIAL ELECT' CAP TR | 155-2261751 |
| C119 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C121 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C122 | 1UF 16V 5MM RADIAL ELECT' CAP TR | 155-1051751 |
| C123 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C124 | 10UF 35V 5MM RADIAL ELECT' CAP TR | 155-1063751 |
| C126 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C127 | SMD 33PF 50V 5% CER COG CAP 0805 (TRS) | 950-3305501 |
| C128 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C129 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C130 | SMD 47NF 50V 10% CER X7R CAP 0805 (TRS) | 950-4735621 |
| C131 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C132 | SMD 10NF 50V 5% CER.CAP 0805 | 950-1035501 |
| C133 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| C134 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| C135 | 47UF 25V 5MM RADIAL ELECT' CAP TR | 155-4762751 |
| C136 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C137 | SMD 10NF 50V 5% CER CAP 0805 | 950-1035621 |
| C140 | 1000UF 16V 5MM RAD ELEC' CAP (10X16) | 155-1081750 |
| C141 | SMD 220NF 50V 20/80% CER Y5V CAP 0805 TR | 950-2245951 |
| C142 | 1UF 63V 5MM BOX POLYESTER CAP TR | 152-1056651 |
| C143 | 1UF 50V 5MM RADIAL ELECT' CAP TR | 155-1055751 |

| | | |
|---|---|---|
| C144 | SMD 1.8NF 50V 5% CER.COG CAP 0805 | 950-1825501 |
| C145 | SMD 1.8NF 50V 5% CER.COG CAP 0805 | 950-1825501 |
| C147 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C148 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C149 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C150 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C151 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C152 | SMD 220PF 50V 5% CER COG CAP 0805 (TRS) | 950-2215501 |
| C153 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C154 | SMD 22NF 50V 10% CER X7R CAP 0805 (TRS) | 950-2235621 |
| C155 | 1UF 63V 5MM BOX POLYESTER CAP TR | 152-1056651 |
| C156 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C157 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C158 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C159 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C160 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C161 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C162 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C163 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C164 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C165 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C166 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C167 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C168 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C169 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C170 | SMD 10PF 50V 5% CER CAP 0805 (TRS) | 950-1005501 |
| C171 | SMD 10PF 50V 5% CER CAP 0805 (TRS) | 950-1005501 |
| C172 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C173 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C174 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C175 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C176 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C177 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C178 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C179 | SMD 470PF 50V 10% CER X7R CAP 0805 (TRS) | 950-4715621 |
| C180 | SMD 470PF 50V 10% CER X7R CAP 0805 (TRS) | 950-4715621 |
| C181 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C182 | 3.3UF 16V 5MM RADIAL ELECT' CAP TR | 155-3351751 |
| C183 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C184 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C185 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C186 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C187 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C188 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C189 | SMD 18PF 50V 5% CER COG CAP 0805 (TRS) | 950-1805501 |
| C190 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C191 | SMD 270PF 50V 5% CER.CAP 0805 (TRS) | 950-2715501 |
| C192 | SMD 39PF 50V 5% CER COG CAP 0805 (TRS) | 950-3905501 |
| C193 | SMD 39PF 50V 5% CER COG CAP 0805 (TRS) | 950-3905501 |
| C194 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C195 | SMD 10PF 50V 5% CER CAP 0805 (TRS) | 950-1005501 |
| C196 | SMD 33PF 50V 5% CER COG CAP 0805 (TRS) | 950-3305501 |
| C197 | SMD 82PF 50V 5% CER COG CAP 0805 (TRS) | 950-8205501 |
| C198 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C199 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C200 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C201 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C203 | SMD 150PF 50V 5% CER COG CAP 0805 (TRS) | 950-1515501 |
| C204 | SMD 18PF 50V 5% CER COG CAP 0805 (TRS) | 950-1805501 |
| C205 | 470NF 50V 5MM M/L CER.CAP TR(MAX WD 3MM) | 157-4745751 |
| C206 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C207 | SMD 33PF 50V 5% CER COG CAP 0805 (TRS) | 950-3305501 |
| C208 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C209 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C210 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C211 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C212 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C213 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C214 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C215 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C216 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C217 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C218 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| C219 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C221 | 1UF 16V 5MM RADIAL ELECT' CAP TR | 155-1051751 |
| C222 | SMD 390PF 50V 5% CER COG CAP 0805 (TRS) | 950-3915501 |
| C223 | SMD 390PF 50V 5% CER COG CAP 0805 (TRS) | 950-3915501 |
| C224 | SMD 18PF 50V 5% CER COG CAP 0805 (TRS) | 950-1805501 |
| C225 | SMD 100PF 50V 5% CER COG CAP 0805 (TRS) | 950-1015501 |
| C230 | SMD 10PF 50V 5% CER CAP 0805 (TRS) | 950-1005501 |
| C231 | 220UF 25V 5MM RADIAL ELECT CAP | 155-2272751 |
| C233 | 220UF 16V 5MM RADIAL ELECT' CAP TR | 155-2271751 |
| C234 | SMD 150PF 50V 5% CER COG CAP 0805 (TRS) | 950-1515501 |
| C236 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C238 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C240 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C241 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C242 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C243 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C244 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C245 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C246 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C247 | 22UF 35V 5MM RADIAL ELECT' CAP | 155-2263751 |
| C248 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C249 | SMD 10NF 50V 10% CER X7R CAP 0805 (TRS) | 950-1035621 |
| C250 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C252 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C253 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C254 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C255 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C256 | 1000UF 25V 5MM RADIAL ELECT CAP | 155-1082751 |
| C257 | SMD 1.8NF 50V 5% CER COG CAP 0805 (TRS) | 950-1825501 |
| C258 | SMD 1.8NF 50V 5% CER COG CAP 0805 (TRS) | 950-1825501 |
| C259 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C260 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C261 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C262 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C264 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C265 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C266 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C267 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| C268 | 100UF 25V 5MM RADIAL ELECT' CAP TR | 155-1072751 |
| C269 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C270 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C271 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C278 | 22UF 16V 5MM RADIAL ELECT' CAP TR | 155-2261751 |
| C279 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C282 | SMD 100NF 50V 20/80% CER Y5V CAP 0805 TR | 950-1045951 |
| C283 | SMD 100PF 50V 5% CER COG CAP 0805 (TRS) | 950-1015501 |
| C284 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C285 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C289 | 100UF 25V 5MM RADIAL ELECT' CAP TR | 155-1072751 |
| C290 | 100UF 25V 5MM RADIAL ELECT' CAP TR | 155-1072751 |
| C291 | SMD 12PF 50V 5% CER COG CAP 0805 (TRS) | 950-1205501 |
| C292 | SMD 100PF 50V 5% CER COG CAP 0805 (TRS) | 950-1015501 |
| C294 | SMD 56PF 50V 5% CER COG CAP 0805 (TRS) | 950-5605501 |
| C295 | SMD 220NF 50V 20/80% CER Y5V CAP 0805 | 950-2245951 |
| C299 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C300 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C301 | SMD 22PF 50V 5% CER COG CAP 0805 (TRS) | 950-2205501 |
| C302 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| C303 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |

| | | |
|---|---|---|
| C305 | SMD 100PF 50V 5% CER COG CAP 0805 (TRS) | 950-1015501 |
| C306 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C307 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| C308 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| C309 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C310 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C313 | SMD 4.7NF 50V 10% CER X7R CAP 0805 (TRS) | 950-4725621 |
| C314 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C315 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C316 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C317 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |

## Diodes

| | | |
|---|---|---|
| D1 | SMD DIODE-BAS19/ISS250 (TE85L) SOT-23 TR | 912-0001951 |
| D2 | SMD DIODE-BB515 MINI PLAST (TRS) | 912-0051501 |
| D3 | SMD DIODE-BB619 MINI PLAST (TRS) | 912-0061901 |
| D4 | DIODE-1N4007 TR | 120-0400701 |
| D5 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D6 | DIODE-1N4007 TR | 120-0400701 |
| D7 | DIODE-1N4007 TR | 120-0400701 |
| D8 | DIODE-1N4007 TR | 120-0400701 |
| D9 | DIODE-BYV96D (PHILIPS) TR | 120-0009611 |
| D10 | DIODE-BYV96D (PHILIPS) TR | 120-0009611 |
| D11 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D12 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D13 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D14 | 3V9 5% 400MW ZENER DIODE TR | 125-0039501 |
| D15 | DIODE-BYV95A (PHILIPS) TR | 120-0009511 |
| D16 | DIODE-BYV95A (PHILIPS) TR | 120-0009511 |
| D17 | DIODE - EGP30B TR | 120-1003001 |
| D18 | DIODE - EGP30B TR | 120-1003001 |
| D20 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D21 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D22 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D23 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D24 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D25 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D26 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D27 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D28 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D29 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D31 | 6V2 2% 400MW ZENER DIODE TR | 125-0062201 |
| D32 | 6V2 2% 400MW ZENER DIODE TR | 125-0062201 |
| D33 | 5V1 2% 400MW ZENER DIODE TR | 125-0051201 |
| D34 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D35 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D36 | DIODE - 1N5817 1.0A 20V SCHOTTKY TR | 120-0581701 |
| D37 | 8V2 5% 400MW ZENER DIODE TR | 125-0082501 |
| D39 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D40 | 4V7 5% 400MW ZENER DIODE TR | 125-0047501 |
| D41 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D42 | 3V0 5% 400MW ZENER DIODE TR | 125-0030501 |
| D43 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D44 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D45 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D46 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| D48 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D49 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D50 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D51 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D58 | 3V0 5% 400MW ZENER DIODE TR | 125-0030501 |
| D59 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D60 | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D61 | 4V7 5% 400MW ZENER DIODE TR | 125-0047501 |
| D62 | 12V 5% 400MW ZENER DIODE | 125-0120501 |

## Inductors

| | | |
|---|---|---|
| L1 | 200NH-COIL(GOLD) AIR WOUND (PEDOKA) | 134-0200080 |
| L2 | 200NH-COIL(GOLD) AIR WOUND (PEDOKA) | 134-0200080 |
| L3 | BALUN-BC0403RID-B (PEDOKA) | 133-0040300 |
| L4 | 18NH-COIL (GOLD) AIR WOUND (PEDOKA) | 134-0018080 |
| L5 | 18NH-COIL (GOLD) AIR WOUND (PEDOKA) | 134-0018080 |
| L6 | 15NH-COIL(RED)AIR WOUND(PEDOKA) (A-26MM) | 134-0015091 |
| L7 | SOUND COIL 4.7UH +-3% SUMIDA HKS-999-035 | 133-0047051 |
| L8 | AXIAL INDUCTOR-33UH 5% TR | 130-0330501 |
| L9 | INDUCTOR-1A 100UH (TDK TSL1110-101K1RO) | 131-1000500 |
| L10 | INDUCTOR-1A 100UH (TDK TSL1110-101K1RO) | 131-1000500 |
| L11 | INDUCTOR-1A 100UH (TDK TSL1110-101K1RO) | 131-1000500 |
| L12 | AXIAL INDUCTOR-680UH 5% TR | 130-6800501 |
| L13 | AXIAL INDUCTOR-1UH 5% TR | 130-0010501 |
| L14 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L15 | 15UH 5% AXIAL INDUCTOR TR | 130-0150501 |
| L16 | 15UH 5% AXIAL INDUCTOR TR | 130-0150501 |
| L17 | 82UH 10% AXIAL INDUCTOR (TDK) T | 134-0820601 |
| L18 | 200NH-COIL(GOLD) AIR WOUND (PEDOKA) | 134-0200080 |
| L19 | 200NH-COIL(GOLD) AIR WOUND (PEDOKA) | 134-0200080 |
| L20 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L21 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L24 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L25 | INDUCTOR-1A 100UH (TDK TSL1110-101K1RO) | 131-1000500 |
| L26 | AXIAL INDUCTOR-100UH 10% DC RES -1.8R TR | 130-1000611 |
| L27 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L28 | AXIAL IND -12UH 5% SRF 19MHZ MIN TR | 130-0120501 |
| L29 | AXIAL IND -12UH 5% SRF 19MHZ MIN TR | 130-0120501 |
| L30 | 15UH 5% AXIAL INDUCTOR TR | 130-0150501 |
| L31 | AXIAL INDUCTOR-22UH 10% TR | 130-0220601 |
| L32 | SOUND COIL 4.7UH +-3% SUMIDA HKS-999-035 | 133-0047051 |
| L33 | AXIAL INDUCTOR-33UH 5% TR | 130-0330501 |
| L34 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L35 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L38 | 10UH 5% AXIAL INDUCTOR (SIEMENS) TR | 130-0100501 |
| L39 | TINNED COPPER WIRE LINKS 0.61MM DIA-PMF | 999P10999O1 |
| L40 | 82UH 10% AXIAL INDUCTOR (TDK) T | 134-0820601 |
| L41 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L42 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| L43 | RAD FERR BEAD(PEDOKA BL02RN2-R62T2) TR | 133-0226201 |

## Links

| | | |
|---|---|---|
| J1 to J11 and LK10 to LK303 are all: | | |
| | TINNED COPPER WIRE LINKS 0.61MM DIA-PMF | 999P10999O1 |
| except: | | |
| J10 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| J11 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| LK207 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |
| LK214 | 5V6 5% 400MW ZENER DIODE TR | 125-0056501 |

## Connectors

| | | |
|---|---|---|
| SK1 ⚠ | "A" LEONHARDY 07-78.1400 MAINS INPUT SKT | 875-0778231 |
| SK2 | SCART SOCKET-JR21A7 21PIN R/ANGLE | 163-2102113 |
| SK3 | SCART SOCKET-JR21A7 21PIN R/ANGLE | 163-2102113 |
| SK4 | SCART SOCKET-JR21A7 21PIN R/ANGLE | 163-2102113 |
| SK5 | PHONO SOCKET-DUAL (JALCO YKC21-0061) | 165-2000201 |

## Transistors

| | | |
|---|---|---|
| Q1 | SMD TRANSISTOR-BFR193 SIEMENS SOT-23 | 911-0019351 |
| Q2 | SMD TRANSISTOR-BFR193 SIEMENS SOT-23 | 911-0019351 |
| Q3 | SMD TRANSISTOR-BC846B SOT-23 | 911-1086551 |
| Q4 | SMD TRANSISTOR-BC846B SOT-23 | 911-1086551 |
| Q5 | TRANSISTOR-MJE 18004 (MOTOROLA) | 110-1800401 |
| Q6 | TRANSISTOR-FXT749 (ZETEX) TR | 110-0079101 |
| Q7 | SMD TRANSISTOR-BC846B SOT-23 | 911-1086551 |
| Q8 | SMD TRANSISTOR-BC846B SOT-23 | 911-1086551 |

| | | |
|---|---|---|
| Q9 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q10 | TRANSISTOR-FXT749 (ZETEX) TR | 110-0074911 |
| Q11 | SMD TRANSISTOR - FMMT591A/BCW67C(SOT-23) | 911-0059151 |
| Q12 | SMD TRANSISTOR - FMMT591A/BCW67C(SOT-23) | 911-0059151 |
| Q13 | SMD TRANSISTOR - FMMT591A/BCW67C(SOT-23) | 911-0059151 |
| Q14 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q15 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q16 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q17 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |
| Q18 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q20 | POWER TRANSISTOR-BD139 NPN TO-126 PAC.TR | 110-0013901 |
| Q23 | SMD TRANSISTOR-ZVN3306F SOT-23 | 911-0330651 |
| Q25 | TRANSISTOR - BD329 NPN TO-126 PACKAGE | 110-0032901 |
| Q26 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q27 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q29 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q30 | TRANSISTOR-FXT749 (ZETEX) TR | 110-0074911 |
| Q31 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q32 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q33 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q34 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q35 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q36 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q37 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q38 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q39 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q40 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |
| Q41 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |
| Q42 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q43 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q44 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q45 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q46 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q47 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q48 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q49 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q50 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |
| Q51 | TRANSISTOR-BC547B NPN TO-92 PACKAGE TR | 110-1054701 |
| Q52 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q53 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q55 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q56 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q57 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q58 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q59 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q60 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q61 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q62 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q63 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q65 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q66 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q67 | SMD TRANSISTOR-BFR193 SIEMENS SOT-23 | 911-0019351 |
| Q68 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q69 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q71 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q72 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q79 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q85 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q86 | TRANSISTOR-BC557 PNP TO-92 PACKAGE TR | 110-0055701 |
| Q90 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q91 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q92 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q93 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |
| Q94 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |
| Q95 | SMD TRANSISTOR-BC846B SOT-23 | 911-1084651 |

## Resistors

| | | |
|---|---|---|
| R1 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R2 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R3 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R4 | SMD 180R 0.1W 5% RES 0805 (TRS) | 940-1810501 |
| R5 | SMD 15R 0.1W 5% RES 0805 (TRS) | 940-1500501 |
| R6 | SMD 12R 0.1W 5% RES 0805 (TRS) | 940-1200501 |
| R7 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R8 | SMD 12R 0.1W 5% RES 0805 (TRS) | 940-1200501 |
| R9 | SMD 120R 0.1W 5% RES 0805 (TRS) | 940-1210501 |
| R10 | SMD 560R 0.1W 5% RES 0805 (TRS) | 940-5610501 |
| R11 | SMD 560R 0.1W 5% RES 0805 (TRS) | 940-5610501 |
| R12 | SMD 560R 0.1W 5% RES 0805 (TRS) | 940-5610501 |
| R13 | SMD 150R 0.1W 5% RES 0805 (TRS) | 940-1510501 |
| R14 | SMD 27R 0.1W 5% RES 0805 (TRS) | 940-2700501 |
| R16 | SMD 22R 0.1W 5% RES 0805 (TRS) | 940-2200501 |
| R17 | SMD 12R 0.1W 5% RES 0805 (TRS) | 940-1200501 |
| R18 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R20 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R21 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R22 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R23 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R24 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R25 | SMD 8K2 0.1W 1% RES 0805 (TRS) | 940-8220101 |
| R26 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R27 | SMD 1K5 0.1W 5% RES 0805 (TRS) | 940-1520501 |
| R28 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R29 | SMD 1K5 0.1W 1% RES 0805 (TRS) | 940-1520101 |
| R30 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R31 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R32 | SMD 22R 0.1W 5% RES 0805 (TRS) | 940-2200501 |
| R33 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R34 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R35 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R36 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R37 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R38 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R39 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R40 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R41 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R42 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R43 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R44 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R45 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R46 | SMD 22R 0.1W 5% RES 0805 (TRS) | 940-2200501 |
| R47 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R48 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R49 | 10R 2W +-25% METOX NON-SPIRAL RES | 143-1007821 |
| R50 | 47K 3W 5% 17.5MM FLAME RETARDANT MOR-3W | 148-4738501 |
| R51 | 15R 0.25W 5% CARBON FILM RES TR | 140-1502501 |
| R52 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R53 | SMD 3K3 0.1W 1% RES 0805 (TRS) | 940-3320101 |
| R54 | SMD 1K 0.1W 1% RES 0805 (TRS) | 940-1020101 |
| R55 | SMD 2K2 0.1W 1% RES 0805 (TRS) | 940-2220101 |
| R56 | SMD 9K1 0.1W 1% RES 0805 (TRS) | 940-9120101 |
| R57 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R58 | 100R 0.25W 5% CARBON FILM RES TR | 140-1012501 |
| R59 | 1R 1WATT 5% METOX NON-SPIRAL RES | 143-0106521 |
| R60 | 1K 5W 10% AX/PLUG CER CASE RES H=15MM | 145-1029600 |
| R61 | 2K2 2W 5% METAL FILM RES TR | 142-2226511 |
| R62 | 68R 0.25W 5% CARBON FILM RES TR | 140-6802501 |
| R63 | 68R 0.25W 5% CARBON FILM RES TR | 140-6802501 |
| R64 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R65 | 4R7 0.25W 5% CARBON FILM RES TR | 140-0472501 |
| R66 | 470R 0.25W 1% METAL FILM RES | 141-4712101 |
| R67 | 470R 0.25W 1% METAL FILM RES | 141-4712101 |

## SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont.)

| | | |
|---|---|---|
| R68 ⚠ | *A* 10M 0.5W VR37 METAL FILM RES TR | 142-1065511 |
| R69 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R70 | SMD 270R 0.1W 5% RES 0805 (TRS) | 940-2710501 |
| R71 | SMD 270R 0.1W 5% RES 0805 (TRS) | 940-2710501 |
| R73 | SMD 390R 0.1W 5% RES 0805 (TRS) | 940-3910501 |
| R74 | SMD 4K7 0.1W 1% RES 0805 (TRS) | 940-4720101 |
| R75 | SMD 820R 0.1W 5% RES 0805 (TRS) | 940-8210501 |
| R76 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R77 | SMD 12K 0.1W 5% RES 0805 (TRS) | 940-1230501 |
| R78 | SMD 220K 0.1W 5% RES 0805 (TRS) | 940-2240501 |
| R79 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R80 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R81 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R82 | SMD 220K 0.1W 5% RES 0805 (TRS) | 940-2240501 |
| R84 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R85 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R86 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R87 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R88 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R89 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R90 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R91 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R92 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R93 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R94 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R98 | SMD 3K9 0.1W 1% RES 0805 (TRS) | 940-3920101 |
| R99 | SMD 3K9 0.1W 1% RES 0805 (TRS) | 940-3920101 |
| R100 | SMD 3K9 0.1W 1% RES 0805 (TRS) | 940-3920101 |
| R103 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R104 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R106 | SMD 620R 0.1W 5% RES 0805 (TRS) | 940-6210501 |
| R107 | SMD 390R 0.1W 5% RES 0805 (TRS) | 940-3910501 |
| R108 | SMD 120R 0.1W 5% RES 0805 (TRS) | 940-1210501 |
| R109 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R110 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R111 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R112 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R113 | SMD 3K3 0.1W 1% RES 0805 (TRS) | 940-3320101 |
| R114 | SMD 33K 0.1W 5% RES 0805 (TRS) | 940-3330501 |
| R115 | SMD 1K2 0.1W 1% RES 0805 (TRS) | 940-1220101 |
| R116 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R117 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R118 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R119 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R120 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R121 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R122 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R123 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R124 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R125 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R126 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R127 | SMD 1M 0.1W 5% RES 0805 (TRS) | 940-1050501 |
| R128 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R129 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R130 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R131 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R132 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R133 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R134 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R135 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R136 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R137 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R138 | SMD 270K 0.1W 5% RES 0805 (TRS) | 940-2740501 |
| R139 | SMD 3K9 0.1W 1% RES 0805 (TRS) | 940-3920101 |
| R140 | SMD 2K7 0.1W 5% RES 0805 (TRS) | 940-2720501 |
| R141 | SMD 3K3 0.1W 1% RES 0805 (TRS) | 940-3320101 |
| R142 | SMD 2K7 0.1W 5% RES 0805 (TRS) | 940-2720501 |
| R143 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R144 | SMD 470K 0.1W 5% RES 0805 (TRS) | 940-4740501 |
| R145 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R146 | SMD 820R 0.1W 5% RES 0805 (TRS) | 940-8210501 |
| R147 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R148 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R149 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R150 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R151 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R154 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R155 | SMD 5K6 0.1W 5% RES 0805 (TRS) | 940-5620501 |
| R156 | SMD 47R 0.1W 5% RES 0805 (TRS) | 940-4700501 |
| R157 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R159 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R160 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R161 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R164 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R165 | SMD 15K 0.1W 5% RES-0805 (TRS) | 940-1530501 |
| R166 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R167 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R168 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R169 | SMD 10R 0.1W 5% RES 0805 (TRS) | 940-1000501 |
| R170 | SMD 10R 0.1W 5% RES 0805 (TRS) | 940-1000501 |
| R171 | SMD 10R 0.1W 5% RES 0805 (TRS) | 940-1000501 |
| R172 | SMD 10R 0.1W 5% RES 0805 (TRS) | 940-1000501 |
| R173 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R174 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R175 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R176 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R177 | SMD 1K2 0.1W 1% RES 0805 (TRS) | 940-1220101 |
| R178 | SMD 1K2 0.1W 1% RES 0805 (TRS) | 940-1220101 |
| R179 | SMD 360R 0.1W 2% RES 0805 (TRS) | 940-3610201 |
| R180 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R188 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R189 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R190 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R191 | SMD 220NF 50V 20/80% CER Y5V CAP 0805 TR | 950-2245951 |
| R192 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R193 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R194 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R195 | 1K2 0.25W 5% CARBON FILM RES TR | 140-1222501 |
| R197 | SMD 1K2 0.1W 5% RES 0805 (TRS) | 940-1220501 |
| R198 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R199 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R205 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R207 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R208 | SMD 1R8 0.1W 5% RES 0805 (TRS) | 940-0180501 |
| R209 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R210 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R211 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R212 | 1K5 0.25W 1% METAL FILM RES TR | 141-1522101 |
| R213 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R215 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R216 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R217 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R218 | SMD 12K 0.1W 1% RES 0805 (TRS) | 940-1230101 |
| R219 | SMD 12K 0.1W 1% RES 0805 (TRS) | 940-1230101 |
| R220 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R222 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R223 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R224 | SMD 15K 0.1W 5% RES 0805 (TRS) | 940-1530501 |
| R225 | SMD 82K 0.1W 5% RES 0805 (TRS) | 940-8230501 |
| R226 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R227 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R228 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R229 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R230 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |

| | | |
|---|---|---|
| R231 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R232 | SMD 1K 0.1W 1% RES 0805 (TRS) | 940-1020101 |
| R233 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R234 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R235 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R236 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R237 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R238 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R239 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R240 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R241 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R242 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R243 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R244 | SMD 39K 0.1W 5% RES 0805 (TRS) | 940-3930501 |
| R245 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R246 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R247 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R248 | SMD 39K 0.1W 5% RES 0805 (TRS) | 940-3930501 |
| R249 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R250 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R251 | 220R 0.25W 5% CARBON FILM RES | 140-2212501 |
| R252 | SMD 220R 0.1W 5% RES 0805 | 940-2210501 |
| R253 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R254 | SMD 9K1 0.1W 1% RES 0805 (TRS) | 940-9120101 |
| R255 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R256 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R257 | SMD 18K 0.1W 1% RES 0805 (TRS) | 940-1830101 |
| R258 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R259 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R260 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R261 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R262 | SMD 18K 0.1W 5% RES 0805 (TR) | 940-1830501 |
| R263 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R264 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R265 | SMD 270R 0.1W 5% RES 0805 (TRS) | 940-2710501 |
| R266 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R267 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R268 | SMD 150R 0.1W 5% RES 0805 (TRS) | 940-1510501 |
| R269 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R270 | SMD 680R 0.1W 5% RES 0805 (TRS) | 940-6810501 |
| R271 | SMD 680R 0.1W 1% RES 0805 (TRS) | 940-6810101 |
| R273 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R274 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R275 | SMD 560R 0.1W 5% RES 0805 (TRS) | 940-5610501 |
| R276 | SMD 120R 0.1W 5% RES 0805 (TRS) | 940-1210501 |
| R278 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R279 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R280 | SMD 180R 0.1W 5% RES 0805 (TRS) | 940-1810501 |
| R281 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R282 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R283 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R284 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R286 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R287 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R288 | SMD 330R 0.1W 5% RES 0805 (TRS) | 940-3310501 |
| R289 | SMD 150R 0.1W 5% RES 0805 (TRS) | 940-1510501 |
| R290 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R291 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R292 | SMD 180R 0.1W 5% RES 0805 (TRS) | 940-1810501 |
| R293 | SMD 1K2 0.1W 5% RES 0805 (TRS) | 940-1220501 |
| R294 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R295 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R296 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R297 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R298 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R299 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R300 | SMD 2K 0.1W 5% RES 0805 (TRS) | 940-2020501 |
| R301 | SMD 270R 0.1W 1% RES 0805 TR | 940-2710101 |
| R302 | SMD 1K 0.1W 1% RES 0805 (TRS) | 940-1020101 |
| R303 | SMD 1K 0.1W 1% RES 0805 (TRS) | 940-1020101 |
| R304 | SMD 150R 0.1W 5% RES 0805 (TRS) | 940-1510501 |
| R305 | SMD 1K1 0.1W 1% RES 0805 (TRS) | 940-1120101 |
| R307 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R308 | SMD 330R 0.1W 5% RES 0805 (TRS) | 940-3310501 |
| R309 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R310 | SMD 6K2 0.1W 5% RES 0805 (TRS) | 940-6220501 |
| R311 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R312 | SMD 390R 0.1W 5% RES 0805 (TRS) | 940-3910501 |
| R313 | SMD 180R 0.1W 5% RES 0805 (TRS) | 940-1810501 |
| R314 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R315 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R316 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R317 | SMD 8K2 0.1W 1% RES 0805 (TRS) | 940-8220101 |
| R318 | SMD 33K 0.1W 5% RES 0805 (TRS) | 940-3330501 |
| R319 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R320 | SMD 33R 0.1W 5% RES 0805 (TRS) | 940-3300501 |
| R321 | SMD 43R 0.1W 5% RES 0805 (TR) | 940-4300501 |
| R327 | SMD 680R 0.1W 1% RES 0805 (TRS) | 940-6810101 |
| R328 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R329 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R330 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R331 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R332 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R333 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R335 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R336 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R337 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R338 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R339 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R340 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R341 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R342 | SMD 270R 0.1W 5% RES 0805 (TRS) | 940-2710501 |
| R343 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |
| R344 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R345 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R346 | SMD 270R 0.1W 5% RES 0805 (TRS) | 940-2710501 |
| R347 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R348 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R349 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R350 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R351 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R353 | SMD 330R 0.1W 5% RES 0805 (TRS) | 940-3310501 |
| R354 | SMD 330R 0.1W 5% RES 0805 (TRS) | 940-3310501 |
| R355 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R356 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R357 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R358 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R359 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R360 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R361 | SMD 6K2 0.1W 5% RES 0805 (TRS) | 940-6220501 |
| R362 | SMD 56R 0.1W 5% RES 0805 (TRS) | 940-5600501 |
| R363 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R364 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R368 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R369 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R370 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R371 | SMD 220K 0.1W 5% RES 0805 (TRS) | 940-2240501 |
| R372 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R373 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R374 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R375 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R376 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |

## SPARES - ELECTRICAL PARTS LISTS FOR MAIN BOARD (cont)

| | | |
|---|---|---|
| R377 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R378 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R379 | SMD 390R 0.1W 5% RES 0805 (TRS) | 940-3910501 |
| R380 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R381 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R382 | SMD 39K 0.1W 5% RES 0805 (TRS) | 940-3930501 |
| R383 | SMD 15K 0.1W 5% RES 0805 (TRS) | 940-1530501 |
| R385 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R386 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R387 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R389 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R390 | SMD 2K7 0.1W 5% RES 0805 (TRS) | 940-2720501 |
| R392 | 47K 3W 5% 17.5MM FLAME RETARDANT MOR-3W | 148-4738501 |
| R396 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R414 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R415 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R416 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R422 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |
| R438 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R439 | 4R7 0.25W 5% CARBON FILM RES TR | 140-0472501 |
| R440 | 1K5 0.25W 1% METAL FILM RES TR | 141-1522101 |
| R442 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R443 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R444 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R445 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R446 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R447 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R448 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R449 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R450 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R451 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R452 | SMD 1R8 0.1W 5% RES 0805 (TRS) | 940-0180501 |
| R454 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R455 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R457 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R458 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R459 | SMD 1K 0.1W 1% RES 0805 (TRS) | 940-1020101 |
| R460 | SMD 1K 0.1W 1% RES 0805 (TRS) | 940-1020101 |
| R461 | 4R7 0.25W 5% CARBON FILM RES TR | 140-0472501 |
| R462 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R463 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R465 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R467 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R474 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R475 | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R476 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R477 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R478 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R479 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R480 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R481 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R482 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R483 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R484 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R485 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R486 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R488 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R491 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R492 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R493 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R494 | SMD 560R 0.1W 5% RES 0805 (TRS) | 940-5610501 |
| R496 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R497 | SMD 1M 0.1W 5% RES 0805 (TRS) | 940-1050501 |
| R499 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R500 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R501 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R502 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R503 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R504 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R505 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R506 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R507 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R509 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R511 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R512 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R514 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R515 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R518 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R519 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R521 | SMD 680R 0.1W 5% RES 0805 (TRS) | 940-6810501 |
| R522 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R523 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R526 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R527 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R528 | SMD 3K3 0.1W 5% RES 0805 (TRS) | 940-3320501 |
| R529 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R530 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R531 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R532 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R533 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R534 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R535 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R536 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R539 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R540 | SMD 3K9 0.1W 5% RES 0805 (TRS) | 940-3920501 |
| R541 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R542 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R543 | SMD 12K 0.1W 5% RES 0805 (TRS) | 940-1230501 |
| R544 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R545 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R547 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R548 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R549 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R550 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R551 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R552 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R555 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R557 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R559 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R560 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R562 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R563 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R564 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R566 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R567 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R568 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R569 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R571 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R573 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R586 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R588 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R589 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R592 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R593 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R598 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R599 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R600 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R601 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| R602 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R603 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R606 | SMD 270R 0.1W 5% RES 0805 (TRS) | 940-2710501 |

## SPARES - ELECTRICAL PARTS LIST FOR MAIN BOARD

### Integrated Circuits

| | | |
|---|---|---|
| U1 | SL5066 VIDEO MODULATOR (PLESSEY) | 109-0506601 |
| U2 | SP4633 SO PRESCALER (PLESSEY) | 109-0463301 |
| U3 | TEA2018 SWITCH MODE PSU (THOMSON) | 109-0201801 |
| **NOTE:** U4 is replaced by U4 extension PCB (see below) | | |
| U5 | SMD IC-74HC4052 (TR) | 902-1405201 |
| U6 | 74LS47 | 101-0004700 |
| U7 | 24C32 32K EE | 104-0243200 |
| U8 | (A VIDEOCRYPT COMPONENT) | 109-0011001 |
| U9 | (A VIDEOCRYPT COMPONENT) | 109-0011401 |
| U10 | (A VIDEOCRYPT COMPONENT) | 109-0011201 |
| U11 | (A VIDEOCRYPT COMPONENT) | 109-0011501 |
| U12 | (A VIDEOCRYPT COMPONENT) | 109-0011101 |
| U13 | (A VIDEOCRYPT COMPONENT) | 109-0011301 |
| U14 | SOUND PROCESSOR MSP3400 "64 PIN DIL" | 109-0340000 |
| U15 | SMD IC-74HC04 (TR) | 902-2000401 |
| U16 | NICKY ASIC 3 | 109-0960103 |
| U17 | M35010-001SP DISPLAY CONT (MISUBISHI) | 109-0350100 |
| U18 | SMD IC-74HC4053 (TR) | 902-1405301 |
| U20 | SMD IC-4053 SO-16 TR | 906-0405302 |
| U21 | SMD IC-74HC4052 (TR) | 902-1405201 |
| U22 | SMD IC-74LS74 (TR) | 901-1007401 |
| U26 | CD4094BCN 8 BIT SHIFT AND STORE REGISTER | 106-0409400 |

### Miscellaneous Components

| | | |
|---|---|---|
| CARD1 | SMART CARD READER-ALCATEL7001LM0416T2F08 | 870-7001001 |
| FIT TO U4: | | |
| 2 OFF | SOCKET 20 WAY TOP ENTRY (HARWIN) | 161-2002001 |
| FIT TO FS1: | | |
| 2 OFF | FUSECLIP-PFC5000-0202 (SMK) | 201-7500001 |
| FS1 ⚠ | "A" FUSE F1AL 20 X 5MM GLASS FAST BLOWN | 201-2521000 |
| IR1 | SONY INFRA-RED REC MODULE (SBX 1620-E2) | 215-1620002 |
| LED1 | 3-UNIT 7-SEG DISPLAY GREEN | 200-7030102 |
| MOD1 | MODULATOR SCREENING CAN-FRAME REV I | 315-0235102 |
| SW1 B | SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW) | 204-0315211 |
| SW2 | SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW) | 204-0315211 |
| SW3 | SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW) | 204-0315211 |
| SW4 B | SWITCH-B3F3152 PCB SUBMIN 150GM (YELLOW) | 204-0315211 |
| T1 | MAINS FILTER-(UF2327S-253-YOR5) "TDK" | 232-2327000 |
| T2 ⚠ | "A" TRANSFORMER-SM MSS200/300 SERIES | 237-0400006 |
| TST1 | TEST PIN-VIDEOCRYPT | 161-1000100 |
| TUNER1 | PACE PC77G01 2GHZ S/LNB FIXED 'F'TUNER | 221-2077012 |
| W1A | TEST PIN-VIDEOCRYPT | 161-1000100 |
| X2 | XTAL 28MHZ HC18U 50/100/-20/30PF PAR 3RD | 170-0280000 |
| X3 | RESONATOR-503KHZ TYPE CSB503F21 | 171-0005030 |
| X4 | XTAL 18.432MHZ HC18U 40/40/10/ 10PF PAR | 170-0184320 |
| X5 | CERAMIC TRAP TPS 4.43MJ | 176-0044301 |
| X6 | XTAL 17.734MHZ HC49U 20/30/10 10PF PAR | 170-0177341 |

### Retrofitted Components

| | | |
|---|---|---|
| Resistor fitted in parallel with L33 (PCO 000309): | | |
| | 2K2 0.25W 5% CARBON FILM RES TR | 140-2222501 |
| Capacitor fitted between pins 5 and 14 of U16 to prevent UHF glitching by improving the phase lock of the modulator: | | |
| | 390PF 100V 5% CERAMIC CAP TR | 150-3917551 |
| Mod. wire fitted between LK203 and R251: | | |
| | MOD WIRE-0.5 X 50MM (INS LENGTH) RED | 190-0505015 |

## SPARES - ELECTRICAL PARTS LIST FOR U4 EXTENSION BOARD

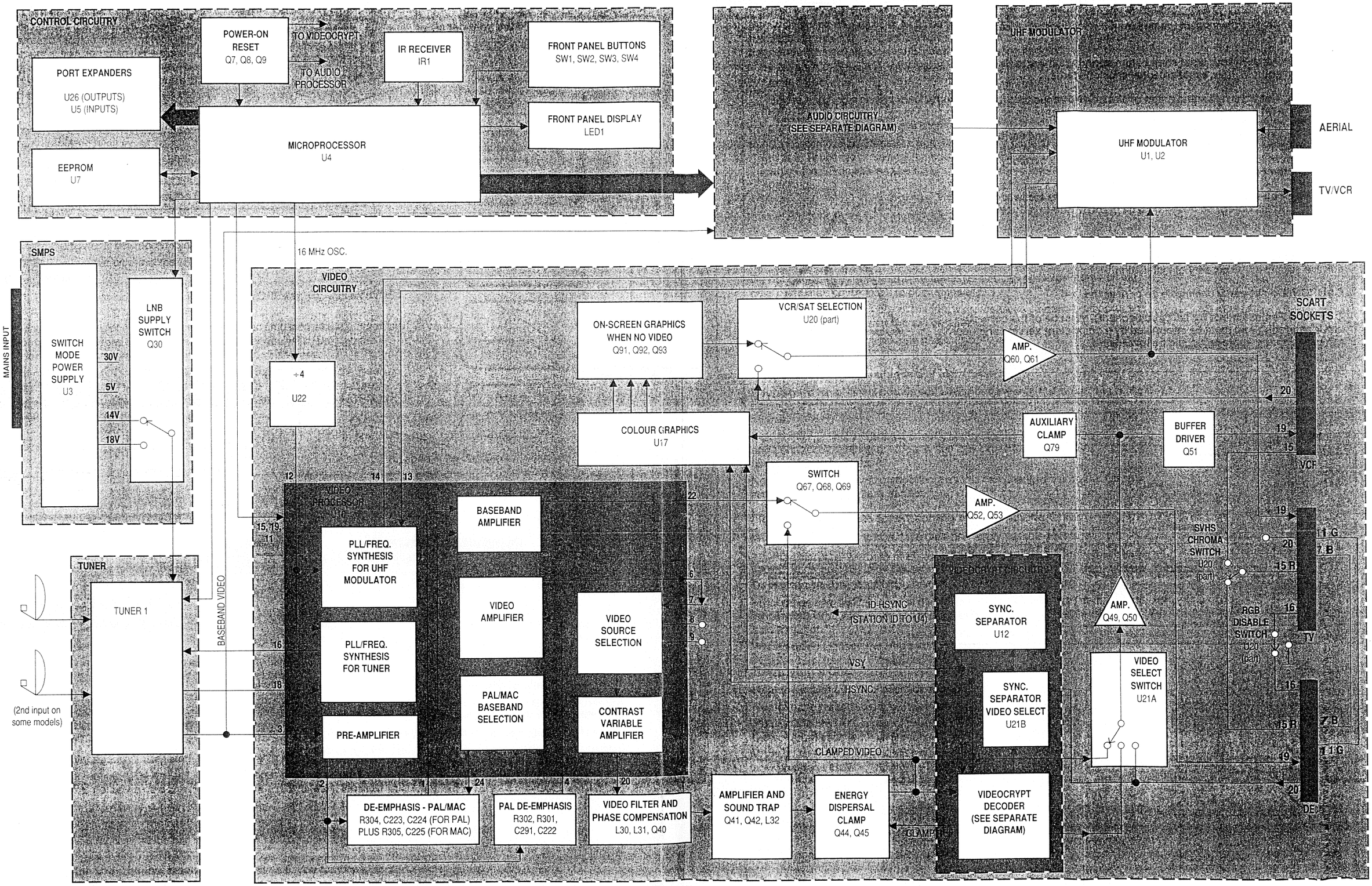
| | | |
|---|---|---|
| C1 | 1UF 50V 5MM M/LAYER CER.CAP TR | 157-1055751 |
| C2 | 100NF 50V 5MM M/LAYER CER.CAP TR | 157-1045751 |
| C3 | 100NF 50V 5MM M/LAYER CER.CAP TR | 157-1045751 |
| C4 | 100NF 50V 5MM M/LAYER CER.CAP TR | 157-1045751 |
| C5 | 33PF 16V 5MM CERAMIC CAP 10% TR | 150-3301651 |
| C6 | 47PF 50V 5% CERAMIC CAP TR | 150-4705551 |
| J1 | TINNED COPPER WIRE LINKS 0.61MM DIA-PMF | 999P1099901 |
| PL 1 | PIN HEADER-20 WAY EXTENDED S/ROW(SAMTEC) | 161-1002002 |
| Note: 2 of these connectors are fitted to make up PL1 | | |
| U1 | SMD IC-Z86C9620VSC ROMLESS Z8 | 904-0869601 |
| U3 | 74HC374 | 102-1037400 |
| U4 | EPROM-27256 MSS201-I ENG V2 (805-0200105) | 805-0200105 |
| FIT TO U4 | | |
| | SOCKET-28 PIN IC DIL | 209-2002800 |
| X1 | XTAL 16MHZ HC18U 50/50/-10+60 30PF PAR | 170-0160000 |
| FIT TO X1 | | |
| | INS.WASHER-FOR HC18/49 (HOLED) XTAL CAN | 208-0153000 |

## SPARES - MECHANICAL PARTS LIST

| | | |
|---|---|---|
| 1 OFF | ADDENDUM SHEET FOR MSS200-I MANUAL | 504-2010105 |
| 1 OFF ⚠ | "A" MAINS CABLE UK "8" (NO PLUG) 1.8M | 191-1015280 |
| 1 OFF ⚠ | "A"MANUAL MSS200-I S/LNB PAL-I PACE | 502-2010100 |
| 1 OFF ⚠ | "A"MSS200-I BAR CODE LAB"E" (721-1000100) | 297-1006800 |
| 1 OFF ⚠ | "A"START-UP GUIDE - MSS200-I MANUAL | 505-2010100 |
| 1 OFF | BAG-POLYTHENE 20X17" FOR MSS1000 UNIT | 400-1201700 |
| 1 OFF | BASE - MSS200/300 UNIVERSAL | 321-3000100 |
| 2 OFF | BATTERY-1.5V AAA | 239-0015000 |
| 1 OFF | BLANKING GROMMET FOR S/LNB OPTION | 306-7890000 |
| 4 OFF | BUMPON-SJ5003 SMALL BLACK DOME | 208-5003010 |
| 1 OFF | CABLE-COAX UHF MALE TO FEMALE | 198-0015021 |
| 1 OFF | CARDBOARD INTERNAL FITMENT MSS200/300 | 444-2300000 |
| 1 OFF | CARTON-MSS200 SERIES PACE PRINTED | 412-2300100 |
| 1 OFF | COVER - MSS200 SERIES (PRE-PAINTED) | 312-2000000 |
| 1 OFF | FSSA/B-INSTALL SHEET ISSUE3 UNBRANDED | 504-8661027 |
| 1 OFF | HALF NUT-3/8 FORM 32 TOI.2A | 240-1380011 |
| 2 OFF | MODULATOR SCREENING CAN-TOP REV I | 315-0235001 |
| 1 OFF | MSS200-I FRONT PANEL | 860-2011100 |
| 1 OFF | MSS SERIES HANDSET PACE BRANDED | 999-1000101 |
| 1 OFF | PAPER WIRE TIE-4" | 206-0040000 |
| 2 OFF | PILLAR-LCBS-14 (RICHCO) | 248-0014002 |
| 2 OFF | PILLAR-SP1-6-01 STAND-OFF (RICHCO) | 248-1601001 |
| 2 OFF | PLASTITE SCREW-4 X 1/4 POZI PAN BLACK | 245-4140011 |
| 1 OFF | PROG LIST SHEET-MSS1000 V/CRYPT UK PACE | 504-1010101 |
| 6 OFF | SCREW-M3 X 8 P/P TAP.C/W WASHER BLK SEAL | 246-3080011 |
| 4 OFF | SNAP RIVET-SR3555B BLACK PLASTIC RICHCO | 247-3555111 |

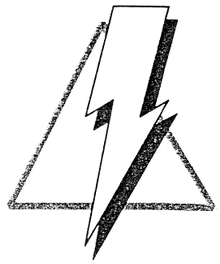
## FOR YOUR OWN SERVICE NOTES

# MAIN BLOCK DIAGRAM



## GAINING ACCESS TO THE UNIT

REMEMBER - SAFETY FIRST



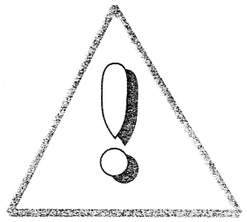
WARNING: Always disconnect the unit from the mains supply before dismantling it.

WARNING: Remove your wrist strap before applying power to the re-assembled equipment to avoid potential shock hazards.

WARNING: The incorrect substitution of electrolytic capacitors may result in an explosion hazard.

CAUTION: Work on an earth mat and wear a wrist strap and earth lead to prevent electrostatic damage to components. Once the main board is removed from the casing it is fairly flexible, so handle it carefully to avoid damaging the components.

CAUTION: You must replace all the PCB fixings, screws etc. when the unit is re-assembled, otherwise there could be hazards due to reduced clearances.

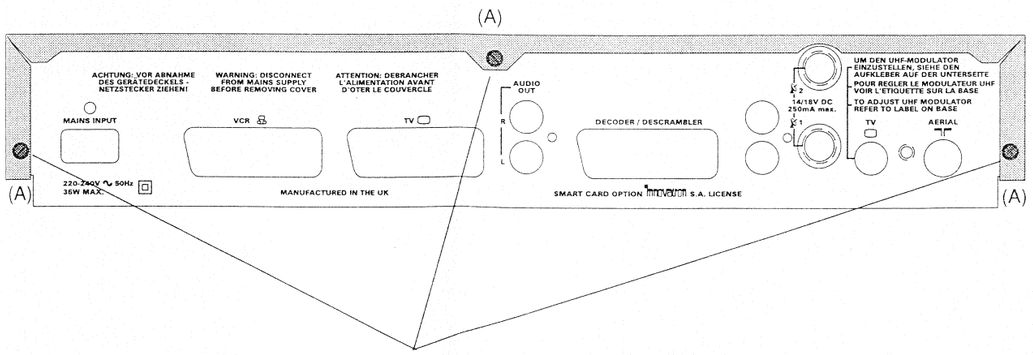


CAUTION: Before you apply mains power to the unit, always ensure that the voltage rating stated on the rear panel of the unit matches the mains voltage supply in the country of installation.

CAUTION: Do not spray chemicals on or near the unit.

CAUTION: Replacements for faulty components must be of the correct value and rating and must be assembled by a competent service engineer, otherwise safety approvals could be invalidated.

## REMOVING THE COVER

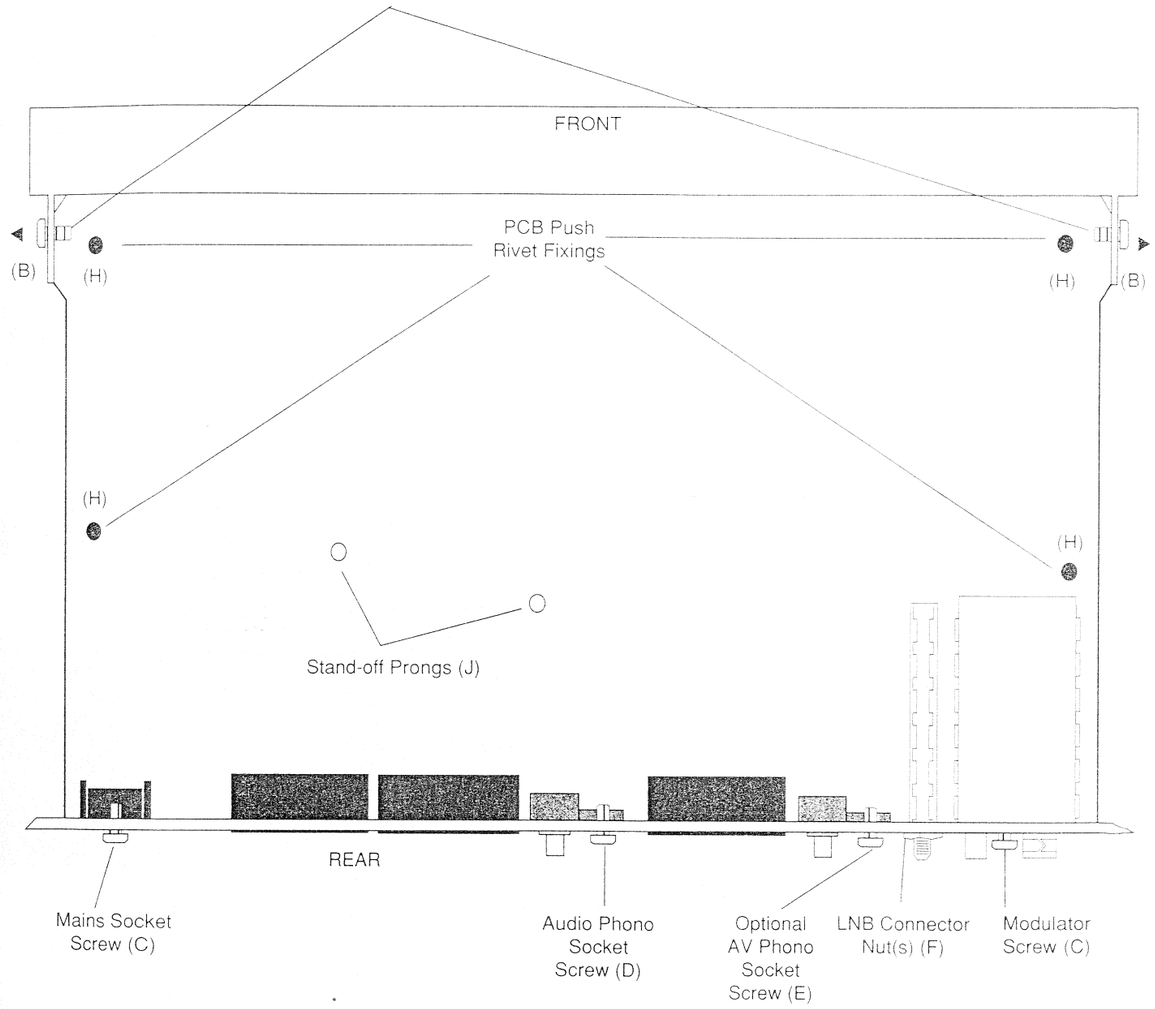



Remove the 3 taptite screws (A) and slide the cover towards the rear.

## REMOVING THE FRONT PANEL AND MAIN BOARD

**To remove the front panel:**

Unscrew the screws (B) at the sides of the unit. Carefully unhook the front panel's side straps from their chassis retaining-clips, then pull the front panel away.




**To remove the main board:**

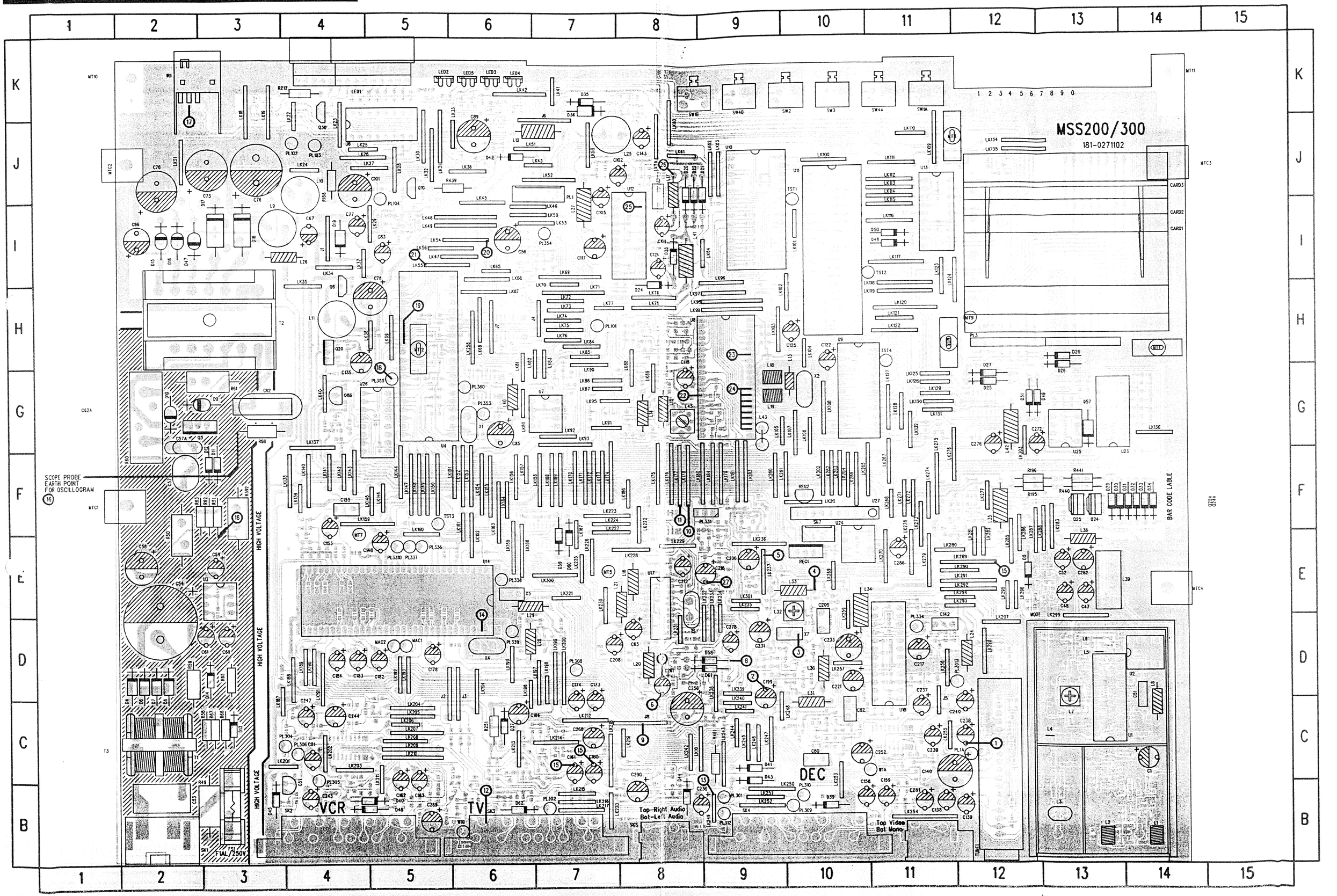
Unscrew the rear-panel screws C, D, E (if present) and G. Use a nut runner to remove the nut(s) (F) from the LNB connector.

Remove the 4 push rivets (H) at the edges of the main board.

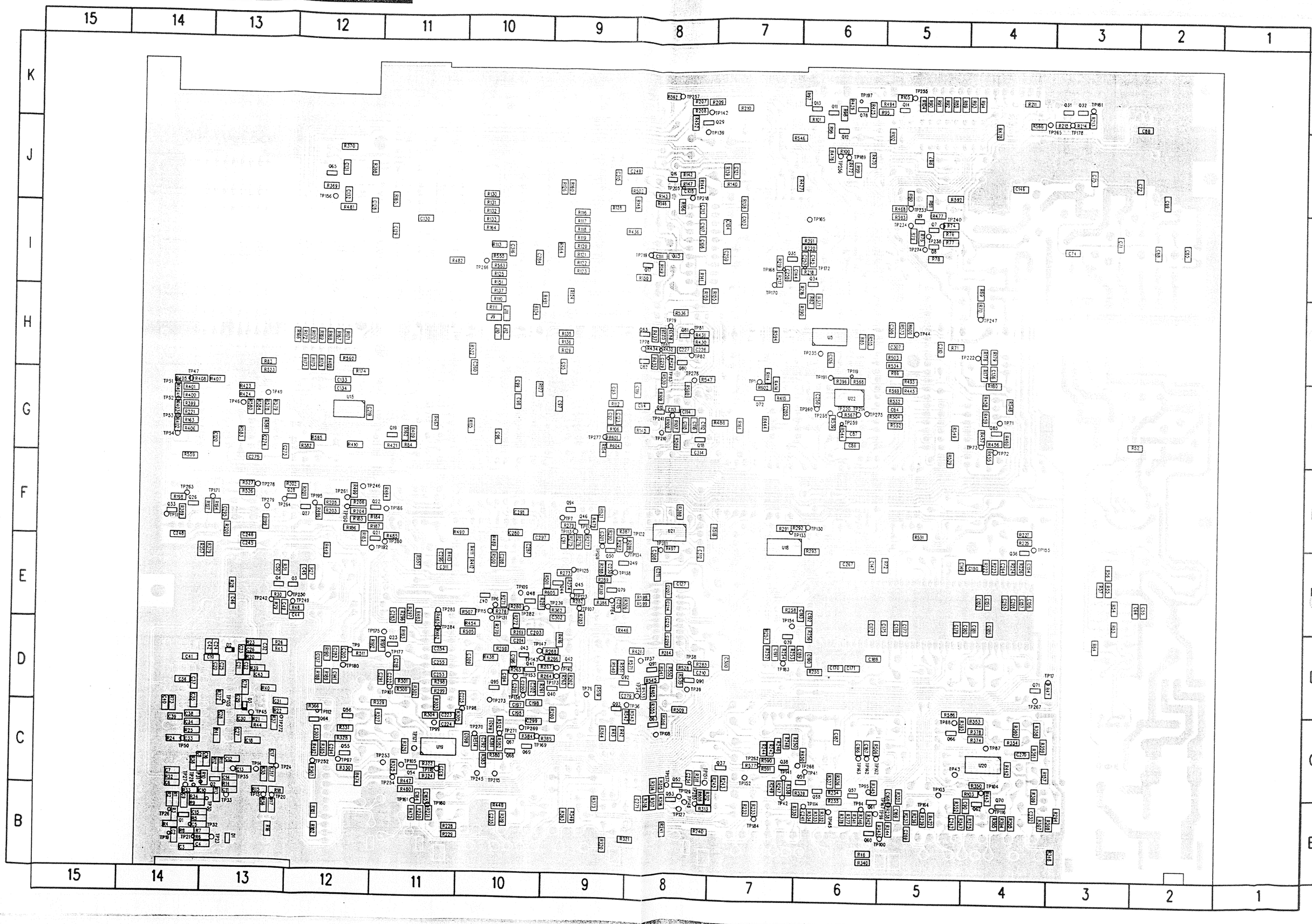
To free the PCB, lift the front edge of the board, and, while doing so, crimp together the stand-off prongs (J) (near the middle of the board) using tweezers.

Gently slide the PCB away from the rear panel.

# MAIN BOARD IDENT DIAGRAM - COMPONENT SIDE



# MAIN BOARD IDENT DIAGRAM - SURFACE MOUNT SIDE



# ADDENDUM SHEET FOR THE MSS 200-I SERVICE MANUAL

**THIS ADDENDUM SHEET IS FOR USE WITH THE MSS 200-I SERVICE MANUAL (PART NO.: 503-2000100). IT COVERS THE DIFFERENCES (AT 11.11.94) BETWEEN THE MSS 200-I AND OTHER RECEIVERS IN THE MSS 200 AND MSS 300 SERIES.**

The main differences between the MSS 200 series and MSS 300 series are:

| | MSS 200 series | | | MSS 300 series | | |
|---|---|---|---|---|---|---|
| | MSS 200-I | MSS 232-G | MSS 248-GR | MSS 301-I | MSS 334-G | MSS 348-GR |
| VideoCrypt | Yes | No | No | Yes | No | No |
| C-band | No | Yes | Yes | No | Yes | Yes |
| Tuner bandwidth | 27 MHz | 18/27 MHz | 15/27 MHz | 27 MHz | 18/27 MHz | 15/27 MHz |
| Number of progs. | 199 | 199 | 199 | 250 | 250 | 250 |
| LNB input | Single | Single | Dual | Dual | Dual | Dual |
| Display | LED | LED | LED | VFD | VFD | VFD |
| AV phono sockets | No | No | Yes | No | No | Yes |
| Polariser | No | No | Yes | No | No | Yes |

Note the following:

- Receivers with dual LNB inputs have additional components in the LNB select and supply circuitry.
- Receivers with a vacuum fluorescent display (VFD) have a separate display PCB which is mounted inside the front panel of the receiver. The display board is currently at Revision A1 and is described in detail starting on page 5 of this addendum.
- MSS 248-GR and MSS 348-GR have additional components fitted for the extra AV phono sockets and for the polariser (see pages 10 and 11).
- Non-VideoCrypt receivers have different components for their own sync. separator circuitry (see page 10). They have a hand modification to the main PCB (which is at Revision A2) to allow the horizontal sync. pulses to reach the microprocessor U4, as these provide the "station ID" for non-VideoCrypt receivers (see page 4). This modification means that R87 has a different value and that R592 and LK84 are not fitted for non-VideoCrypt receivers.
- C29 has a different value for non-VideoCrypt receivers as it determines whether the receiver is PAL I or PAL G.
- C126 is a zerohm link for the non-VideoCrypt receivers; this keeps the VC_STATUS line permanently low.
- Certain components shown in the VideoCrypt circuit diagram need to be fitted for non-VideoCrypt receivers. R42, R43 and LK228 provide biasing for an external decoder. R369 (a zerohm link) and R370 are pull-down resistors. L41 is a wire link for non-VideoCrypt receivers. For the MSS 248-GR and MSS 348-GR, L42 is fitted.
- By 11.11.94, the MSS 200-I had had its masked microprocessor U4 fitted (see page 12 of this sheet) whereas the other models still contain a U4 extension PCB. This means that, currently, X1, C86 and C87 are only fitted on the MSS 200-I, and that on the other models R593 still retains its old value.
- There are also various mechanical differences between the models: lists of the differences are given on page 3.

The parts lists and circuit diagrams in this sheet include information from all Engineering Change Orders (ECOs) up to and including ECO S000861 and all Production Change Orders (PCOs) up to and including PCO S000405, provided that these ECOs and PCOs had an effectivity date on or before 11.11.94.

Page 12 of this addendum gives changes which have occurred in the MSS 200-I since the main service manual (Part no: 503-2000100) went to print (i.e. changes between 17.08.94 and 11.11.94). Many of these changes also apply to the other models; note that the parts lists comparisons given on page 4 compare the status at 11.11.94.

Further changes will be given in technical bulletins or further addendum sheets until the main manual is re-issued.

## ERRORS IN MSS 200-I SERVICE MANUAL (PART NO: 503-2000100)

The following minor errors in the MSS 200-I manual should be corrected as follows:

In the Outline Specification (page 4) the LNB tone switching frequency should be 22 kHz ±2 kHz.

The LEVEL key on the handset (page 6) can be used to display the preset volume level.

"Setting the Positioner Pol. Option" (page 10) applies only to certain MSP995 positioners and the MSP200.

In the diagram on page 15, the direct connection between pin 1 of U16 and C224 should be removed.

Contrast setting at the Picture Menu (page 16) must be between 3 and 7 for optimal VideoCrypt operation.

References on pages 23 and 24 to the control line IN/EXT should read INT/EXT.

In the description of the oscillogram at Test Point 20 (page 32), the three buttons are labelled ⏻, ▲ and ▼.

PACE

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504-2000101

# SOFTWARE AND OTHER DIFFERENCES

## IN THE OUTLINE SPECIFICATION

### GENERAL

| | |
|---|---|
| Number of Programmes | 250 (MSS 300 series); 199 (MSS 200 series) |
| Front Panel Control | There is a shape button instead of the authorise button (MSS 300 series)<br>There is no authorise button (MSS 232-G and MSS 248-GR) |
| UHF Modulator | CCIR PAL System I (MSS 200-I and MSS 301-I)<br>CCIR PAL System G (MSS 232-G, MSS248-GR, MSS 334-G, MSS 348-GR) |

### CONNECTORS

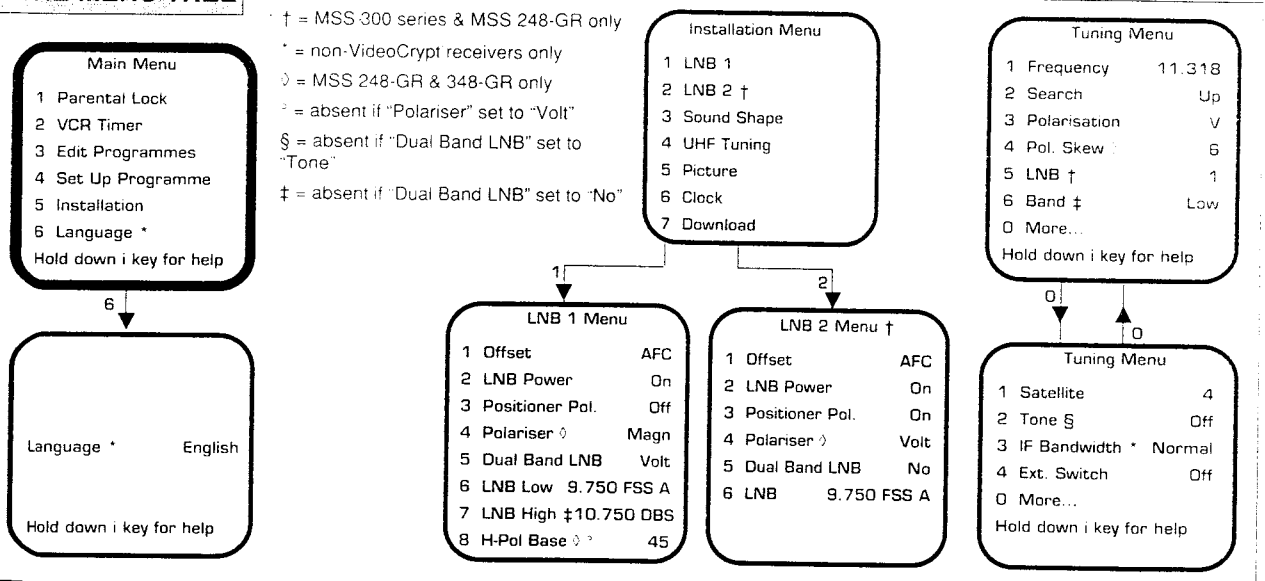
| | |
|---|---|
| LNB | Single F-type (MSS 200-I & MSS 232-G); dual F-type (MSS 300 series & MSS 248-GR) |
| AV Phono Sockets | Present on MSS 248-GR and MSS 348-GR only |
| Polariser Connector | Present on MSS 248-GR and MSS 348-GR only |

### TUNER

| | |
|---|---|
| Receiving Freq. Range | 700 - 2150 MHz (all models exept MSS 200-I)<br>920 - 2050 MHz (MSS 200-I) (soon to be upgraded to the above) |
| I.F. Bandwidth | 27 MHz (MSS 200-I and MSS 301-I)<br>18/27 MHz (MSS 232-G and MSS 334-G)<br>15/27 MHz (MSS 248-GR and MSS 348-GR) |

## IN THE MENU TREE

† = MSS 300 series & MSS 248-GR only
* = non-VideoCrypt receivers only
◊ = MSS 248-GR & 348-GR only
° = absent if "Polariser" set to "Volt"
§ = absent if "Dual Band LNB" set to "Tone"
‡ = absent if "Dual Band LNB" set to "No"




## IN SETTING UP THE RECEIVER FOR THE ATTACHED LNB(S)

For the MSS 300 series and the MSS 248-GR, there are two LNB inputs, and the receiver is preset for both LNB 1 and LNB 2 to be 9.750 FSS A. You need to press MENU, 5, 2 to reach the LNB 2 Menu.

### Changing the Offset

To change the offset for LNB 2, save the offset for LNB 1 and return to normal viewing mode. Select a programme being received at LNB 2, then display the LNB 2 Menu to change the "Offset" option.

### Turning the LNB Power On/Off

If "On" is set at both LNB Menus, power goes only to the LNB which is receiving the current programme.

### Changing the LNB Setting

An additional band is available for non-VideoCrypt receivers:

| LNB Band | Freq. Range (GHz) | Typical Satellites |
|---|---|---|
| 5.150 CBand | 3.700 – 4.200 | Arabsat |

Note that you cannot use the number keys to key in C-Band frequencies at the Tuning Menu; you must use ◄ and ►. CBand becomes an additional available band for both LNB High and LNB Low.

## IN THE OSCILLOGRAMS

The main board oscillograms are the same for VideoCrypt and non-VideoCrypt receivers, except that the following text is added for non-VideoCrypt receivers:

**At Test Point 10:** LK178

**If the trace is not as shown, check:**

- Q80, Q81, Q82, Q83 and associated components in the sync. separator circuitry
- Check that the trace is also at pin 39 of U4; if it is not, check the path including the mod. wire between hole 5 of U8 and LK84.

**At Test Point 11:** LK177

**If the trace is not as shown, check:**

- Q80, Q81, Q82, Q83 and associated components in the sync. separator circuitry.

## OTHER DIFFERENCES

As the MSS 300 series receivers have a vacuum fluorescent display (VFD), the displayed channel number during UHF tuning is of the form CH38FT0 where 38 is the default channel number and FT is the fine tune value. During PIN reset the message RESET PIN appears on the front panel display.

U1, the processor on the display board, decodes the IR1 data and communicates with U4 on the main board. The power supply provides –21 V at pin 6 of T2 and this passes to the display board, where it is needed for the VFD.

To reach the Download Menu in MSS 300 series and MSS 248-GR receivers, press MENU, 5, 7.

## MECHANICAL PARTS LIST DIFFERENCES BETWEEN THE MODELS (at 11.11.94)

Below are details of the differences in mechanical parts for the various models in the MSS 200 and MSS 300 series. In each case they are compared with the MSS 200-I, whose mechanical parts are listed in the main manual (with updates on page 12 of this addendum).

### The following mechanical parts are required on all models which have a U4 extension PCB rather than a masked U4:

FIT TO U4:

| | | |
|---|---|---|
| 2 OFF | SOCKET 20 WAY TOP ENTRY (HARWIN) | 161-2002001 |

OTP SUPPORT:

| | | |
|---|---|---|
| 1 OFF | PILLAR - LCBS- 14 (RICHCO) | 248-0014002 |

### The following MSS 301-I mechanical parts are different from the MSS 200-I:

| | | |
|---|---|---|
| 1 OFF | "A"MANUAL MSS301-I D/LNB PAL-I PACE | 502-3010100 |
| 1 OFF | "A"START-UP GUIDE - MSS301-I MANUAL | 505-3010100 |
| 1 OFF | CABLE-10WAY 125MM MSS300 DISPLAY FFC | 198-0125100 |
| 1 OFF | CARTON-MSS300 BRANDED PACE (POLY SIZE) | 412-0300101 |
| 1 OFF | COVER-MSS300 SERIES | 312-3000000 |
| 1 OFF | FRONT PANEL- MSS301-I D/LNB IRD PACE | 360-3011100 |
| 2 OFF | MSS 300 END CAP | 442-0300100 |

Note that the end cap is fitted instead of the polystyrene.

| | | |
|---|---|---|
| 1 OFF | VFD PIN SUPPORT STRIP | 249-3000100 |

The numbers of the following components have increased to:

| | | |
|---|---|---|
| 2 OFF | HALF NUT-3/8 FORM TOI.2A | 240-1380011 |
| 4 OFF | PLASTITE SCREW-4 X 1/4 POZI PAN BLACK | 245-4140011 |

The blanking grommet (part no: 306-7890000) is not fitted on MSS 301-I.

### The following MSS 232-G mechanical parts are different from the MSS 200-I:

| | | |
|---|---|---|
| 1 OFF | "A" MAINS CABLE-EURO "8" + 2 PIN PLUG | 191-2015280 |
| 1 OFF | "A"MANUAL MSS232-G S/LNB PAL-G PACE | 502-2000100 |
| 1 OFF | "A"START-UP GUIDE - MSS232-G MANUAL | 505-2020100 |
| 1 OFF | CABLE-COAX UHF M-TO-F 1.5M BLACK "FTZ" | 198-0015121 |
| 1 OFF | MSS232-G FRONT PANEL | 360-2000100 |
| 1 OFF | PROG LIST SHEET - MSS1034-G NON-IRD PACE | 504-1001100 |

### The following MSS 334-G mechanical parts are different from the MSS 200-I:

| | | |
|---|---|---|
| 1 OFF | "A" MAINS CABLE-EURO "8" + 2 PIN PLUG | 191-2015280 |
| 1 OFF | "A"MAN MSS2/300 SER PAL-G D/LNB (ENG/GER) | 502-2100100 |
| 1 OFF | "A"START/GUIDE - MSS2/300 SER PAL-G D/LNB | 505-2230100 |
| 1 OFF | CABLE-COAX UHF M-TO-F 1.5M BLACK "FTZ" | 198-0015121 |
| 1 OFF | CABLE-10WAY 125MM MSS300 DISPLAY FFC | 198-0125100 |
| 1 OFF | CARTON-MSS300 BRANDED PACE (POLY SIZE) | 412-0300101 |
| 1 OFF | COVER-MSS300 SERIES | 312-3000000 |
| 1 OFF | MSS334-G FRONT PANEL | 360-3000100 |
| 2 OFF | MSS 300 END CAP | 442-0300100 |

Note that the end cap is fitted instead of the polystyrene.

| | | |
|---|---|---|
| 1 OFF | PROG LIST SHEET - MSS1034-G NON-IRD PACE | 504-1001100 |
| 1 OFF | VFD PIN SUPPORT STRIP | 249-3000100 |

The numbers of the following components have increased to:

| | | |
|---|---|---|
| 2 OFF | HALF NUT-3/8 FORM TOI.2A | 240-1380011 |
| 4 OFF | PLASTITE SCREW-4 X 1/4 POZI PAN BLACK | 245-4140011 |

The blanking grommet (part no: 306-7890000) is not fitted on MSS 334-G.

### The mechanical parts for the MSS 248-GR and MSS 348-GR are the same as for the MSS 232-G and MSS 334-G respectively, except that the base and manuals are different (as given below) and there are some additional components:

| | | |
|---|---|---|
| 1 OFF | "A"MAN MSS2/300 SER PAL-G D/LNB (ENG/GER) | 502-2100100 |
| 1 OFF | "A"START/GUIDE - MSS2/300 SER PAL-G D/LNB | 505-2230100 |
| 1 OFF | MSS248/348 METAL BASE IRTE/2PHONO | 321-3001100 |
| 1 OFF | CABLE - 5 WAY 165MM RIBBON FFC | 198-0165050 |
| 3 OFF | PLASTITE SCREW-4 X 1/4 POZI PAN BLACK | 245-4140011 |

The blanking grommet (part no: 306-7890000) is not fitted on MSS 248-GR.

# ELECTRICAL PARTS LIST DIFFERENCES BETWEEN THE MODELS (at 11.11.94)

This page gives electrical parts list differences (for the main board) between the various models in the MSS 200 and MSS 300 series. See page 6 for the display board parts list and page 11 for the polariser electrical parts.

## Models currently have different tuners as follows:

| | | |
|---|---|---|
| **MSS200** | PACE PC77G01 2GHZ S/LNB FIXED 'F'TUN | 221-2077012 |
| **MSS232** | PACE PC78G04 2.15GHZ S/LNB (18/27)'F'TUN | 221-2078042 |
| **MSS248** | PACE PG78G03 2.15GHZ D/LNB (15/27) 'F' TUN | 221-2178032 |
| **MSS301** | PACE PG78G01 2.15GHZ D/LNB FIXED 'F' TUN | 221-2178012 |
| **MSS334** | PACE PG78G04 2.15GHZ D/LNB (18/27) 'F' TUN | 221-2178042 |
| **MSS348** | PACE PG78G03 2.15GHZ D/LNB (15/27) 'F' TUN | 221-2178032 |

## Each model has a different U4 on an extension PCB as follows (MSS 200-I now has masked U4 - see page 12):

| | | |
|---|---|---|
| **MSS232** | EPROM-27256 MSS232 4-LANG (805-0200101) | 805-0200101 |
| **MSS301** | EPROM-27256 MSS300 ENG (805-0300100) | 805-0300100 |
| **MSS334** | EPROM-27256 MSS334 4-LANG (805-0300101) | 805-0300101 |

For models without a masked U4, R593 is different as follows.

| | | |
|---|---|---|
| R593 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |

Note that the MSS 248-GR and MSS 348-GR should have the masked U4 right from the start of manufacture as follows:

| | | |
|---|---|---|
| **MSS248** | 8663 PROC MSS200 ALL SERIES (809-8663207) | 809-8663207 |
| **MSS348** | 8663 PROC MSS300 UNIVERSAL (809-8663301) | 809-8663301 |

## The following components which are fitted on the MSS 200-I and MSS 301-I main board are not fitted on the non-VideoCrypt receivers:

C91-99, C102-119, C121-124, C128, C129, C131, C132, C135, C136, C219, C249, C259, C260, C284, C308, C313-316, CARD1, D20-28, D42, D48-51, D59, D60, J5, J10, J11, L13-15, L18, L19, L27, L42 *, L43, HAND MODIFICATION - ECO S000772A (see page 6 of this sheet) LK59, LK60, LK62-64, LK66, LK69, LK79, LK84, LK86, LK90, LK91, LK95-99, LK105-107, LK109, LK112-120, LK122-127, LK134, LK172, LK173, LK183, LK222, Q9, Q10, Q15-18, Q20, Q46, Q65, Q72, R78-81, R106-151, R154-156, R159-161, R164-180, R279, R291-293, R368, R414, R439, R467, R481, R482, R488, R491, R522, R555, R560, R563, R564, R588, R592, R601, R602, TST1, U8-13, U15, U18, X2, X3

* L42 is fitted on MSS 248-GR and 348-GR but not on 232-G or 334-G

## The following MSS 300 series/MSS 248-GR parts are different from MSS 200-I/232-G parts or are not fitted on the main board of MSS 200-I/232-G receivers:

| | | |
|---|---|---|
| C101 | 1000UF 35V DJ3 RADIAL ELECT CAP 5MM TR | 855-1083951 |
| C138* | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C139* | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C146 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| D30* | SIGNAL DIODE-1N4148 75MA 75V TR | 120-0414801 |
| D47 | DIODE-BYV95A (PHILIPS) TR | 120-0009511 |
| PL1 | FE CONNECTOR-10 WAY TOP ENTRY FE-10-BT | 161-2001010 |
| Q21* | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q22* | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q24* | TRANSISTOR - BD329 NPN TO-126 PACKAGE | 110-0032901 |
| Q28* | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| R158 | 2K7 0.25W 5% CARBON FILM RES TR | 140-2722501 |
| R181* | SMD 22R 0.1W 5% RES 0805 (TRS) | 940-2200501 |
| R182* | SMD 22R 0.1W 5% RES 0805 (TRS) | 940-2200501 |
| R183* | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R185* | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R186* | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R187* | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R196* | 1K2 0.25W 5% CARBON FILM RES TR | 140-1222501 |
| R200* | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R203* | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R204* | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R206* | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R441* | 1K5 0.25W 1% METAL FILM RES TR | 141-1522101 |
| R546 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |

* = fitted on the MSS 248-GR as it is a dual-input model.

## The following components which are fitted on the MSS 200 series receivers are not fitted on the main board of the MSS 300 series receivers:

IR1, J7*, L12, LED1, Q11-14, R88-94, R98-100, R104, R494, SW1B, SW2, SW3, SW4B, U6

* = not fitted on the MSS 248-GR as it is a dual-input model.

## The following parts for non-VideoCrypt models are different from the MSS 200-I/301-I parts or are not fitted in the MSS 200-I/301-I receivers:

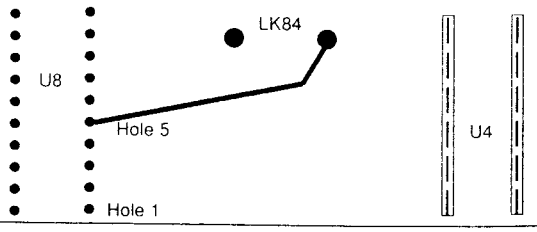
| | | |
|---|---|---|
| C29 | SMD 180PF 50V 5% CER COG CAP 0805 TR | 950-1815501 |
| C126 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| C226 | SMD 270PF 50V 5% CER.CAP 0805 (TRS) | 950-2715501 |
| C227 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C228 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C229 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C237 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| C239 | 47UF 16V 5MM RADIAL ELECT' CAP TR | 155-4761751 |
| J4 | TINNED COPPER WIRE LINKS 0.61MM DIA-PMF | 999P1099901 |
| L41 | TINNED COPPER WIRE LINKS 0.61MM DIA-PMF | 999P1099901 |
| Q54 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| Q64 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| Q80 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| Q81 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q82 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| Q83 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |
| R56 | SMD 6K2 0.1W 1% RES 0805 (TRS) | 940-6220101 |
| R87 | SMD 2K2 0.1W 1% RES 0805 (TRS) | 940-2220101 |
| R277 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R322 | SMD 0.1W 5% ZEROHM LINK 0805 (TRS) | 940-0000501 |
| R323 | SMD 680R 0.1W 5% RES 0805 (TRS) | 940-6810501 |
| R324 | SMD 3K9 0.1W 5% RES 0805 (TRS) | 940-3920501 |
| R325 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R365 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R366 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R367 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R369 | SMD 0.1W 5% ZEROHM LINK 0805 (TRS) | 940-0000501 |
| R428 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R429 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R430 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R431 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R432 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R433 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R434 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R435 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R436 | SMD 22K 0.1W 5% RES 0805 (TRS) | 940-2230501 |
| R437 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| U19 | SMD IC-74HC4053 (TR) | 902-1405301 |

## Hand modification to route the horizontal sync. pulses to the the microprocessor U4 (ECO S000743).

For this ECO the wire link LK84 was removed, and the following mod. wire added between hole 5 of U8 and LK84 as shown in the diagram below.

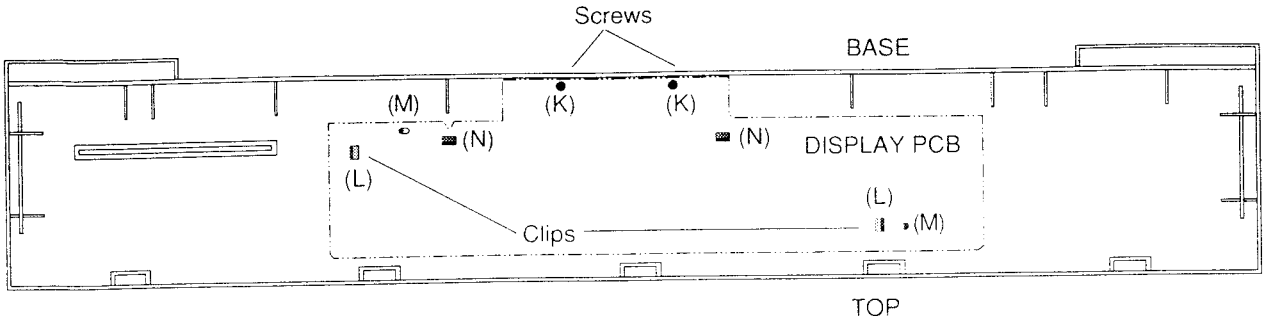
| | | |
|---|---|---|
| | MOD WIRE-0.5 X 60MM BLACK | 190-0506001 |

In addition in ECO S000743, the value of R87 changed and then it changed again in ECO S000796 to the value given in the list shown above.



## REMOVING THE DISPLAY BOARD FROM THE FRONT PANEL

Before attemping to remove the display board from inside the front panel, unplug the ribbon cable which connects the display board to PL1 on the main PCB.



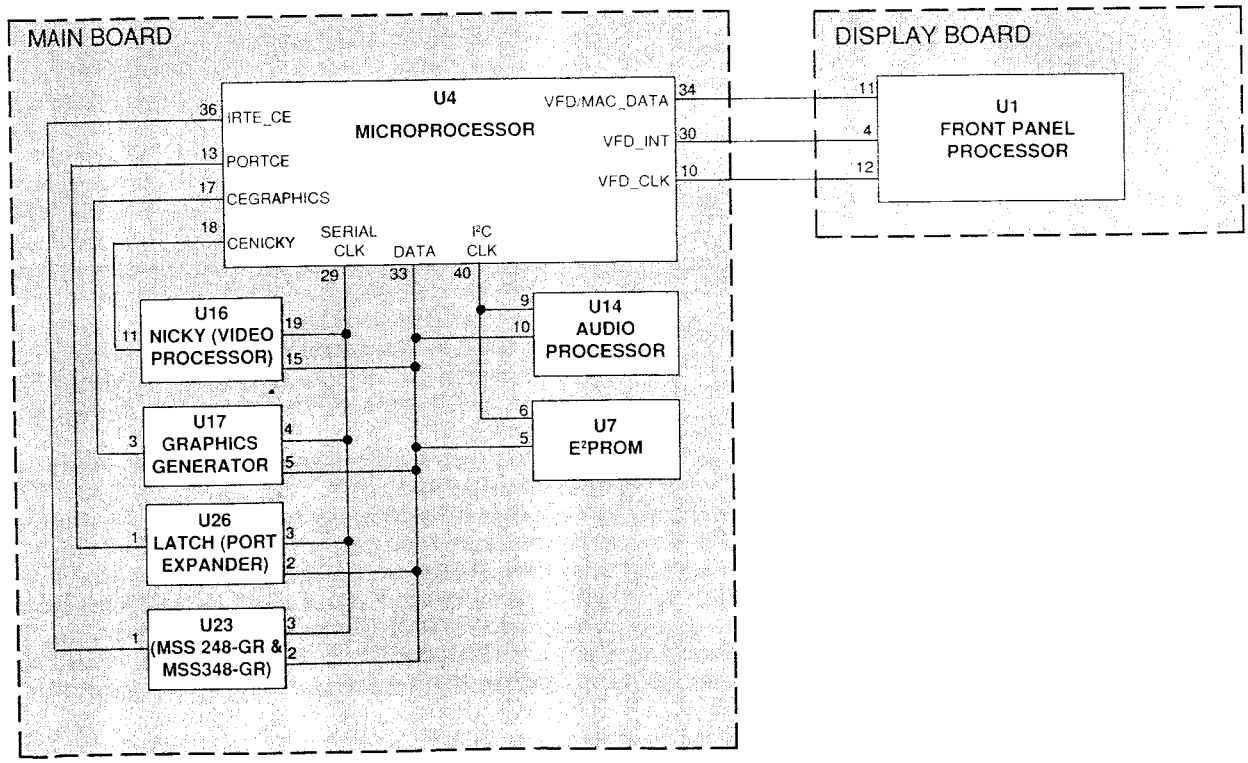

Remove the 2 screws (K).

Gently pull back the 2 clips (L) to release the PCB and lift it from the front panel.

To re-insert the PCB, locate the holes (M) over the location posts inside the front panel moulding and push it down over the clips (L). Refasten the screws (K) (torque: 35 to 40 Ncm).

**Note on removing the VFD from the display PCB:** Pull back the 2 clips (N) (the pins of the VFD are still soldered to the PCB).

## BLOCK DIAGRAM OF CLOCK AND DATA CONTROL LINES



# GRID REFS AND ELECTRICAL PARTS LIST FOR DISPLAY BOARD

## GRID REFS - DISPLAY CIRCUIT DIAGRAM

* = not fitted

### CAPACITORS

| | |
|---|---|
| C1 | D6 |
| C2 | D3 |
| C3* | B3 |
| C4* | B3 |
| C5 | B3 |
| C6 | B3 |
| C7 | B2 |
| C8 | D3 |
| C10 | C1 |
| C11 | C1 |
| C12 | B2 |
| C15 | B3 |
| C16 | B3 |
| C17 | B3 |
| C18 | D6 |
| C19 | B3 |
| C20 | B1 |
| C21 | B1 |
| C22 | C2 |
| C23 | D3 |
| C24 | D3 |
| C25 | D3 |

### DIODES

| | |
|---|---|
| D1 | D2 |
| D2 | D2 |

### INDUCTORS

| | |
|---|---|
| L1 | B2 |

### LINKS

| | |
|---|---|
| J1 | B3 |

### CONNECTORS

| | |
|---|---|
| PL1 | B1 |

### TRANSISTORS

| | |
|---|---|
| Q1 | C5 |
| Q2 | B5 |
| Q3 | B5 |
| Q4 | A5 |
| Q5 | D3 |
| Q6 | D3 |
| Q7 | A5 |
| Q8 | D2 |
| Q9 | D3 |

### RESISTORS

| | |
|---|---|
| R1 | D6 |
| R2 | D6 |
| R3* | C5 |
| R4 | C5 |
| R5* | B5 |
| R6 | B5 |
| R7* | B5 |
| R8 | B5 |
| R9* | B5 |
| R10 | A5 |
| R13* | A5 |
| R14 | A5 |
| R16 | B3 |
| R17 | C6 |
| R18 | B6 |
| R19 | B6 |
| R20 | B6 |
| R21 | A6 |
| R22 | D3 |
| R24 | A3 |
| R25 | A3 |
| R26 | D2 |
| R27 | D2 |
| R28 | D2 |
| R29 | D3 |
| R30 | D3 |
| R31 | D3 |
| R32 | B1 |

### ICS

| | |
|---|---|
| U1 | B4 |

### MISC. COMPONENTS

| | |
|---|---|
| IR1 | B2 |
| SW1 | A3 |
| SW2 | A3 |
| SW3 | A3 |
| SW4 | A3 |
| VFD1 | D6 |
| X1 | B3 |

## GRID REFS - DISPLAY PCB IDENT DIAGRAMS

* = not fitted
† = on SMD side of PCB

### CAPACITORS

| | |
|---|---|
| C1 | C9 |
| C2 | C2 |
| C3 | B6† |
| C4 | B6† |
| C5 | B7 |
| C6 | B5† |
| C7 | C7† |
| C8 | C2† |
| C10 | B9† |
| C11 | B9 |
| C12 | C8 |
| C15 | C5† |
| C16 | C5† |
| C17 | C5† |
| C18 | C8 |
| C19 | B5† |
| C20 | B7† |
| C21 | C8† |
| C22 | B9 |
| C23 | C3† |
| C24 | C2† |
| C25 | C2 |

### DIODES

| | |
|---|---|
| D1 | C2† |
| D2 | C2† |

### INDUCTORS

| | |
|---|---|
| L1 | C7 |

### LINKS

| | |
|---|---|
| J1 | C4† |

### CONNECTORS

| | |
|---|---|
| PL1 | C8 |

### TRANSISTORS

| | |
|---|---|
| Q1 | C6† |
| Q2 | C7† |
| Q3 | C6† |
| Q4 | C6† |
| Q5 | C2 |
| Q6 | C2 |
| Q7 | C7† |
| Q8 | C2† |
| Q9 | C2† |

### RESISTORS

| | |
|---|---|
| R1 | B8 |
| R2 | B8 |
| R3 | B6† |
| R4 | B6† |
| R5 | B7† |
| R6 | B7† |
| R7 | C6† |
| R8 | C6† |
| R9 | C6† |
| R10 | C6† |
| R13 | C7† |
| R14 | C7† |
| R16 | C5† |
| R17 | C6† |
| R18 | C6† |
| R19 | C6† |
| R20 | C6† |
| R21 | C6† |
| R22 | C2† |
| R24 | B6† |
| R25 | B5† |
| R26 | C2† |
| R27 | C2† |
| R28 | C2† |
| R29 | C2† |
| R30 | C3 |
| R31 | C3 |
| R32 | C8 |

### ICS

| | |
|---|---|
| U1 | C4 |

### MISC. COMPONENTS

| | |
|---|---|
| IR1 | C7 |
| SW1 | B5 |
| SW2 | B4 |
| SW3 | B6 |
| SW4 | B4 |
| VFD1 | C4 |
| X1 | B6 |

## PARTS LIST - DISPLAY BOARD

| | | |
|---|---|---|
| **Capacitors** | | |
| C1 | 100UF 25V 2.5MM RADIAL ELECT' CAP | 155-1072720 |
| C2 | 22UF 35V 5MM 20% MINI RAD ELECT' CAP TR | 156-2263752 |
| C5 | 330UF 10V 3.5MM 20% MINI. RAD. ELECT CAP | 156-3371730 |
| C6 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C7 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C8 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C10 | SMD 100NF 50V 20/80% CER Y5V CAP 0805 TR | 950-1045951 |
| C11 | 10UF 50V 20% 5MM MINI RAD ELECT' CAP TR | 156-1065751 |
| C12 | 10UF 50V 20% 5MM MINI RAD ELECT' CAP TR | 156-1065751 |
| C15 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C16 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C17 | SMD 1NF 50V 5% CER COG CAP 0805 (TRS) | 950-1025501 |
| C18 | 330UF 25V 3.5MM RADIAL ELECT' CAP | 155-3372730 |
| C19 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C20 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C21 | SMD 220NF 25V 20/80% CER Y5V CAP 0805 TR | 950-2242951 |
| C22 | 10UF 50V 20% 5MM MINI RAD ELECT' CAP TR | 156-1065751 |
| C23 | SMD 3.3NF 50V 5% CER X7R CAP 0805 (TRS) | 950-3325521 |
| C24 | SMD 3.3NF 50V 5% CER X7R CAP 0805 (TRS) | 950-3325521 |
| C25 | 22UF 35V 5MM 20% MINI RAD ELEC' CAP TR | 156-2263751 |
| **Diodes** | | |
| D1 | SMD DIODE-BAS16/DAN212KT146 SOT-23 | 912-0001651 |
| D2 | SMD DIODE-BAS16/DAN212KT146 SOT-23 | 912-0001651 |
| **Inductors** | | |
| L1 | AXIAL INDUCTOR-18UH 10% DC RES <0.8R TR | 130-0180611 |
| **Links** | | |
| J1 | SMD 0.1W 5% ZEROHM LINK-0805 (TRS) | 940-0000501 |
| **Connectors** | | |
| PL1 | FE CONNECTOR - 10 WAY SIDE ENTRY JST | 161-2101010 |
| **Transistors** | | |
| Q1 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q2 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q3 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q4 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q5 | TRANSISTOR-BC557 PNP TO-92 PACKAGE TR | 110-0055701 |
| Q6 | TRANSISTOR-ZTX450 (ZETEX) TR | 110-0045011 |
| Q7 | SMD TRANSISTOR-BC856B SOT-23 | 911-1085651 |
| Q8 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| Q9 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |
| **Resistors** | | |
| R1 | 22K 0.25W 5% CARBON FILM RES TR | 140-2232501 |
| R2 | 2K2 0.25W 5% CARBON FILM RES TR | 140-2222501 |
| R4 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R6 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R8 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R10 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R14 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R16 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R17 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R18 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R19 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R20 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R21 | SMD 47K 0.1W 5% RES 0805 (TRS) | 940-4730501 |
| R22 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R24 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R25 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R26 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R27 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R28 | SMD 15K 0.1W 5% RES 0805 (TRS) | 940-1530501 |
| R29 | SMD 12K 0.1W 5% RES 0805 (TRS) | 940-1230501 |
| R30 | 220R 0.25W 5% CARBON FILM RES TR | 140-2212501 |
| R31 | 220R 0.25W 5% CARBON FILM RES TR | 140-2212501 |
| R32 | 22R 1W 5% CARBON FILM RES TR | 140-2206501 |
| **Integrated Circuits** | | |
| U1 | PANASONIC MICRO MN158418PCEM MSS1000 | 809-1584001 |
| **Miscellaneous Components** | | |
| IR1 | SONY INFRA-RED REC MODULE (SBX 1610-E2) | 215-1610002 |
| SW1 | SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR) | 204-0100502 |
| SW2 | SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR) | 204-0100502 |
| SW3 | SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR) | 204-0100502 |
| SW4 | SWITCH-B3F6005 PCB STANDARD(=B3F1005 TR) | 204-0100502 |
| VFD1 | VAC/FLUORESCENT DISP 11-MT-94GK | 200-0119400 |
| X1 | RESONATOR- CST 4.00 MGW-TF01 MURATA | 171-0040000 |

# CIRCUIT DIAGRAM FOR DISPLAY BOARD

VFD1
11-MT-94GK
VAC/FLUORESCENT DISPLAY

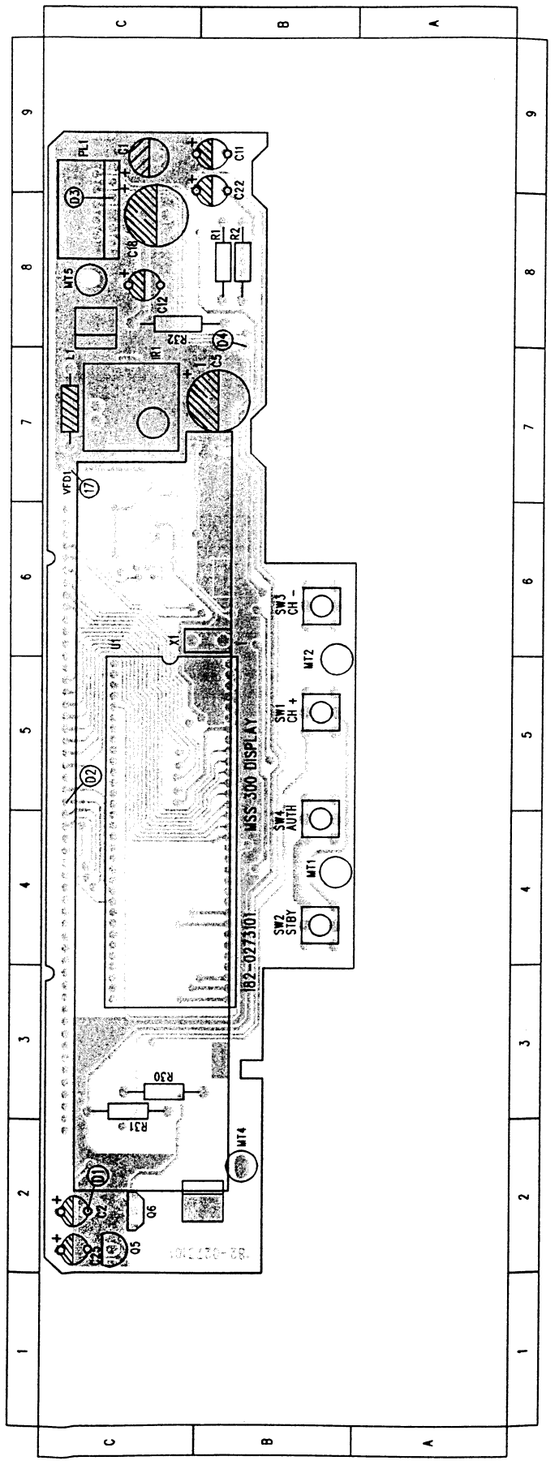
U1
MN158418PCEM
(809-1584001)

PL1
FE CONNECTOR
10 WAY SIDE ENTRY

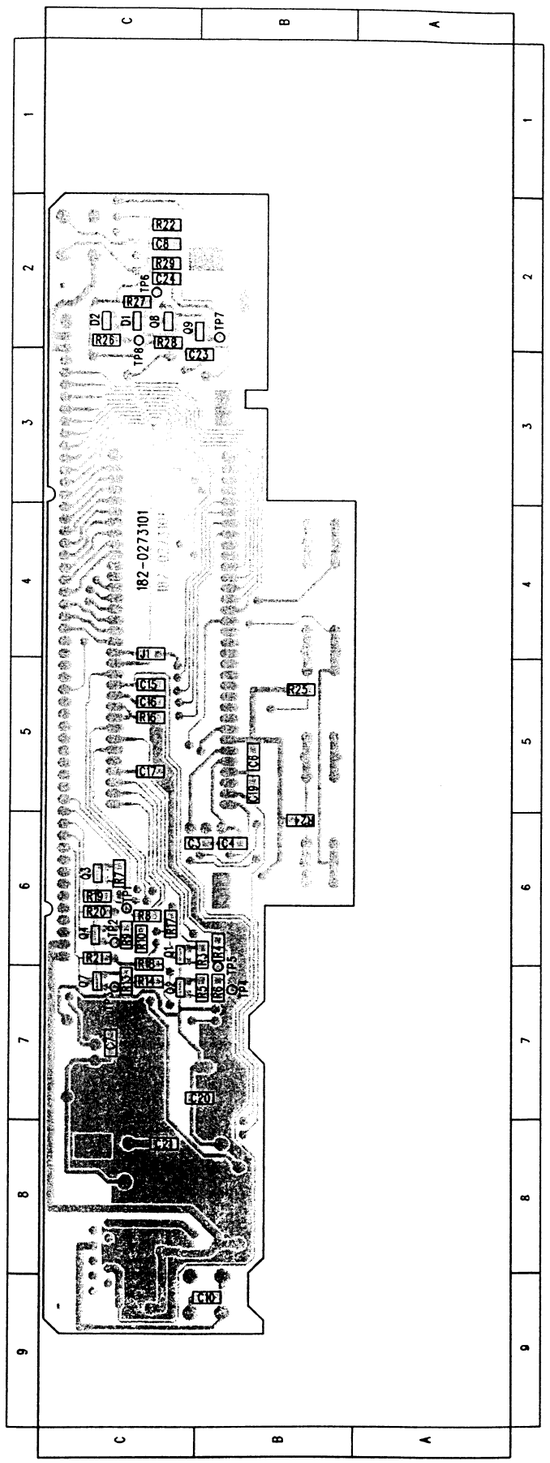
NOTES
N/F = NOT FITTED.
ALL 0805 CAPACITORS 5% 50V UNLESS OTHERWISE STATED.
ALL 0805 RESISTORS 5% 0.1W UNLESS OTHERWISE STATED.
ALL ELECTROLYTIC CAPACITORS 16V UNLESS OTHERWISE STATED.

## DISPLAY BOARD IDENT DIAGRAMS

**COMPONENT SIDE**




**SOLDER SIDE**




## DISPLAY BOARD CIRCUIT DESCRIPTION

The circuit diagram for the display board is on page 7 of this addendum. The display board comprises an infra-red sensor for the handset commands, the front panel buttons, a vacuum fluorescent display (VFD1) and a microprocessor U1 which controls what appears on the VFD and also the passage of information to the microprocessor U4 on the main PCB.

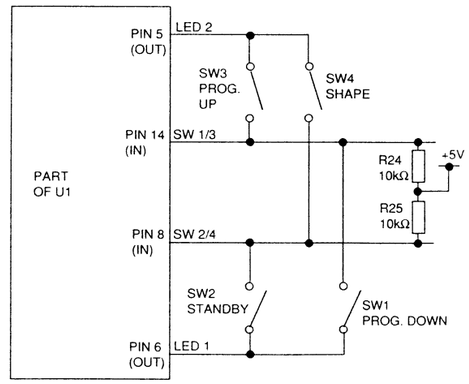
When the receiver powers up, the reset line RST (from the main board) causes pin 63 of U1 to go high. The data, clock and interrupt logic are seen on pins 11, 12 and 4 respectively of U1 and these pass to the main PCB on pins 7, 8 and 6 of PL1 via a ribbon cable to PL1 on the main PCB. When the handset keys are pressed, IR data (see Oscillogram 17) is seen on pin 13 of U1. The microprocessor U1 runs at 4 MHz, determined by crystal X1.

### Front Panel Switches

The diagram below shows a simplified version of the switching circuitry. At any instant, output pins 5 and 6 of microprocessor U1 can never both be high, although they will both be low when the receiver is in standby. The input pins 8 and 14 of U1 are normally pulled high by R24 and R25.

U1 checks whether the front panel switches are open or closed as follows. It sets pin 5 low (and therefore pin 6 high) momentarily and checks whether pin 14 is high or low. If it is low, then SW3 (the programme up button) must be closed; if it is high then SW3 must be open. While pin 5 is still low, U1 then checks whether pin 8 is high or low. If it is low then SW4 (the shape button) must be closed; if it is high then SW4 must be open. To check the other two switches, U1 then sets pin 6 low (and therefore pin 5 high) momentarily and checks again whether pin 14 is high or low. If it is low, then SW1 (the programme down button) must be closed; if it is high then SW1 must be open. While pin 6 is still low, U1 then checks whether pin 8 is high or low. If it is low then SW2 (the standby button) must be closed; if it is high then SW2 must be open. If SW2 is detected as being closed, U1 causes the word "Standby" to illuminate on the VFD.

The closing and opening of SW4 causes a stepping through the four preset sound shapes. U1 keeps track of which shape is currently applied and steps to the next in the sequence if a change in SW4 is detected.




**NOTE: Switch Idents on PCB**

The PCB idents for the switches do not represent the current funtionality, given below.

| Ident | Function |
|---|---|
| SW1 CH+ | Programme down |
| SW2 STBY | Standby |
| SW3 CH– | Programme up |
| SW4 AUTH | Sound shape |

### Vacuum Fluorescent Display

The supply to the VFD is derived from the +14 V supply at pin 1 of PL1 and the -21 V supply at pin 4 of PL1, this being attached by ribbon cable to PL1 on the main board. Q8 and Q9 form a 22 kHz oscillator, running constantly, whose output is AC coupled via C8 to drive transistors Q5 and Q6, which act as a push-pull pair. This provides an 8 V peak-peak square wave (50% mark to space ratio) which is AC coupled via C2 and drives the filament wires within the VFD (these can be seen as thin horizontal wires across the front of the display). The resistors R1 and R2 hold the filament wires at a DC level of approximately -16 V. R26 and C22 are a reset for the oscillator circuit to ensure it starts on power-up.

The supplied current to the filament wires cause them to heat up and emit electrons. When a segment of the display is turned on (by the application of a positive voltage) the segment attracts the electrons which strike the phosphor coating in the VFD causing it to glow in the applicable segment.

# OSCILLOGRAMS FOR DISPLAY BOARD FAULT TRACING

**NOTE:** Oscillogram 17 in the main MSS 200-I Service Manual, which shows the trace at pin 2 of IR1, also applies to the MSS 300 series, except in this case IR1 is located on the display board.

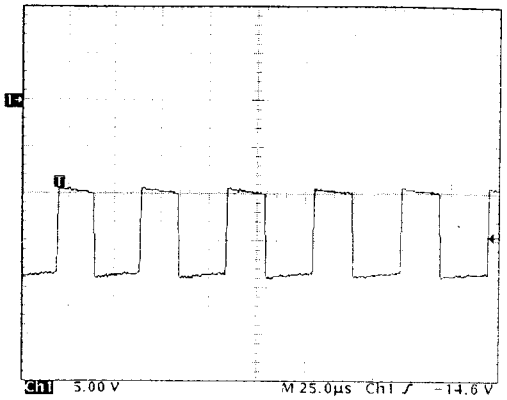
**Test Point D1:** Pin 52 of display (VFD1) (Display PCB)

**Description:** The presence of a trace shows that the vacuum fluorescent display can operate.

**If the trace is not detected, check:**

- Q6, Q5 and associated components on the display PCB;
- Q8, Q9 and associated components on the display PCB which form the oscillator for the 22 kHz signal.

D1. CONTROL DISPLAY PCB




**Test Point D2:** Pin 25 of VFD1 (Display PCB)

**Description:** This shows segment 6 of the VFD when SKY NEWS is displayed. The segment numbers diagram on page 9 shows that segment 6 is illuminated for many of the characters.

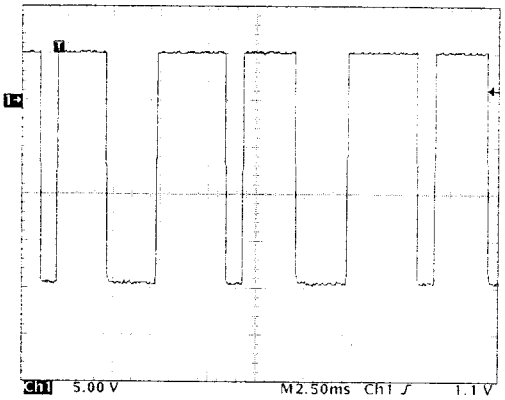
Check that the trace goes from +5 V (illuminated) to –21 V (extinguished). The mark/space ratio depends on the characters displayed. Other segments show a similar trace, but note that for certain combinations of displayed programme names and segments the whole trace may be at -21 V or (unlikely) at +5 V.

The trace for any grid (e.g. pins 4 to 14 of VFD1) should be at +5 V for one eleventh of the time period.

**If the trace is not similar to that shown, check:**

- VFD1, U1 and associated circuitry;
- Q1, Q2, Q3, Q4, Q7 if you suspect grids 11, 10, 9, 8, 7 respectively.

D2. CONTROL DISPLAY PCB




**Test Point D3:** Pin 11 of display processor U1 (Display PCB), which is the same as pin 7 of PL1.

**Description:** The trace shows a typical data signal (VFD/MAC_ DATA) when the handset keys are pressed to change the programme number.

Press the number keys while looking for the trace.

The trace should also look the same at pin 34 of U4 on the main PCB.

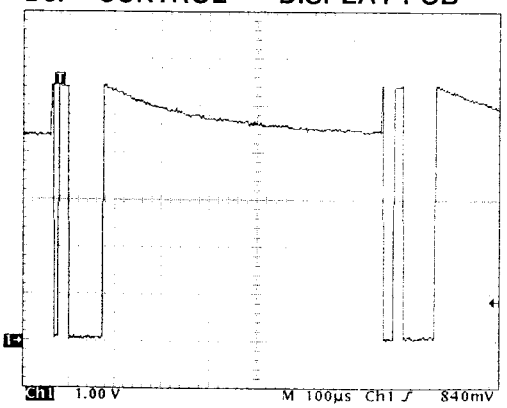
**If the trace is not detected, check:**

- U1.

**If the trace is present at U1 but not at U4, check:**

- PL1 on both the main and display PCBs and the ribbon cable between them.

D3. CONTROL DISPLAY PCB




**Test Point D4:** Pin 12 of display processor U1 (Display PCB), which is the same as pin 8 of PL1.

**Description:** The trace shows a typical clock signal (VFD_ CLK) when the handset keys are pressed to change the programme number.

Press the number keys while looking for the trace.

The trace should also look the same at pin 10 of U4 on the main PCB.

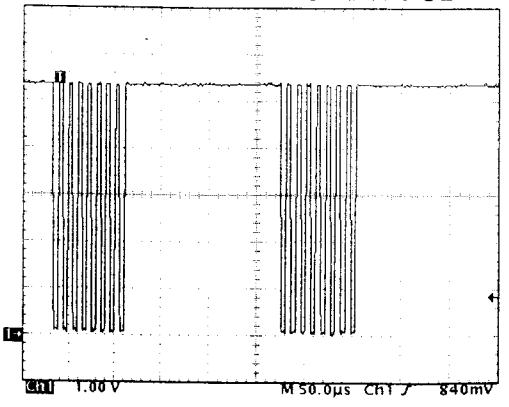
**If the trace is not detected, check:**

- U1.

**If the trace is present at U1 but not at U4, check:**

- PL1 on both the main and display PCBs and the ribbon cable between them.

D4. CONTROL DISPLAY PCB



The positive voltage applied to cause illumination is +5 V; the segments are at -21 V when they are extinguished.

The microprocessor U1 controls all of the multiplexing of the lines to the VFD and therefore which segments illuminate at any given instant. Q1, Q2, Q3, Q4 and Q7 are buffer drivers. The illumination of each particular part of the display is controlled by a "grid" line and a "segment" line. The display is divided into 11 grids, grids 1 to 10 being the characters of the 10-character display (starting at the right-hand side) and grid 11 being the rest of the display, as shown in the diagram at the bottom of the page (note that in normal operation, some parts of grid 11 will never illuminate). Each grid is then divided into 35 segments, as shown in the separate diagram of a single character. Each part (generally each word) of grid 11 is a segment.

If you notice a fault in the display, the diagrams allow you to see which grid or segment is affected and therefore which of the tracks on the display PCB should be checked for breaks or shorts. The table (right) cross-references the grid and segment numbers with the pins on the VFD and on U1. There is also a self test sequence for the VFD.

| Grid No. | VFD Pin | U1 Pin |
|---|---|---|
| 1 | 4 | 47 |
| 2 | 5 | 36 |
| 3 | 6 | 37 |
| 4 | 7 | 38 |
| 5 | 8 | 39 |
| 6 | 9 | 56 |
| 7 | 10 | 64 |
| 8 | 11 | 1 |
| 9 | 12 | 2 |
| 10 | 13 | 3 |
| 11 | 14 | 7 |
| **Seg. No.** | **VFD Pin** | **U1 Pin** |
| 1 | 28 | 16 |
| 2 | 29 | 17 |
| 3 | 30 | 18 |
| 4 | 27 | 19 |
| 5 | 26 | 20 |
| 6 | 25 | 21 |
| 7 | 24 | 22 |
| 8 | 23 | 23 |
| 9 | 22 | 48 |
| 10 | 21 | 49 |
| 11 | 20 | 50 |
| 12 | 19 | 51 |
| 13 | 18 | 52 |
| 14 | 17 | 53 |
| 15 | 16 | 54 |
| 16 | 15 | 55 |
| 17 | 31 | 24 |
| 18 | 32 | 25 |
| 19 | 33 | 26 |
| 20 | 34 | 27 |
| 21 | 35 | 28 |
| 22 | 36 | 29 |
| 23 | 37 | 30 |
| 24 | 38 | 31 |
| 25 | 39 | 32 |
| 26 | 40 | 33 |
| 27 | 41 | 34 |
| 28 | 42 | 35 |
| 29 | 43 | 40 |
| 30 | 44 | 41 |
| 31 | 45 | 42 |
| 32 | 46 | 43 |
| 33 | 47 | 44 |
| 34 | 48 | 45 |
| 35, 36 | 49 | 46 |

### Self Test

To start the test, display the Main Menu then quickly press F, 6, STORE.

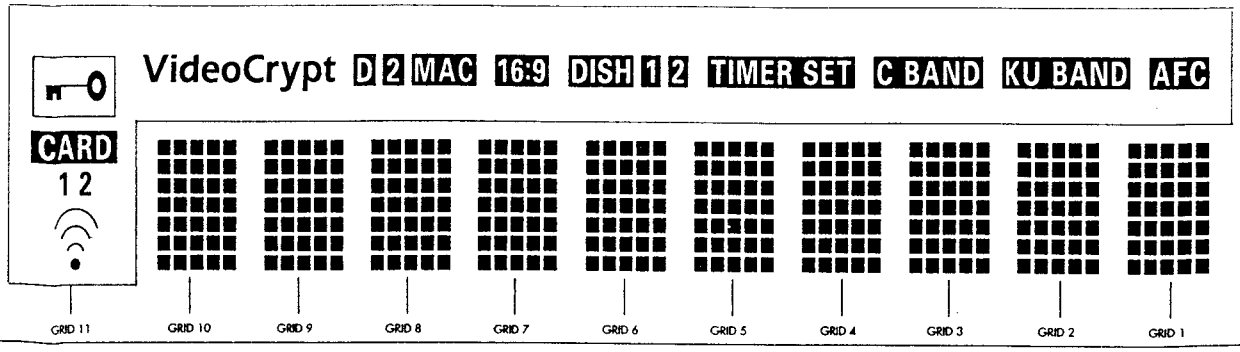
The display then illuminates in the following sequence:

- the words "SELF TEST" are displayed;
- the software number is displayed;
- all the grids and segments are illuminated simultaneously;
- each segment is displayed in turn in the form of the word "SEG" followed by a number, alongside which a dot illuminates for each segment in turn (as in the diagram below);
- each grid illuminates in turn;
- the words "ROTARY 00" are displayed, which you should ignore;
- the word "PRESS SW10" is displayed, at which point you should press the ▲ switch (SW1) several times to check it is operating correctly (sequential numbers after the "1" on the display indicate this);
- the preceding step is repeated for each front panel switch in turn (i.e. SW2 is ⏻, SW3 is ▼ and SW4 is SHAPE) and for each you should press the appropriate switch several times to test it.

At the end of this test sequence, "TEST END" is displayed and the self test keeps repeating until you press the NORM key to return to normal viewing mode.

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 |

Segment numbers for grids 1 to 10



## MSS 248-GR AND MSS 348-GR RECEIVERS

These receivers contain circuitry to control an electromagnetic or mechanical polariser, as described in the following section.

They also have two additional phono sockets, one for mono audio and one for video. These are mentioned in the main MSS 200-I Service Manual and are intended for use in countries where SCART connections are not used.

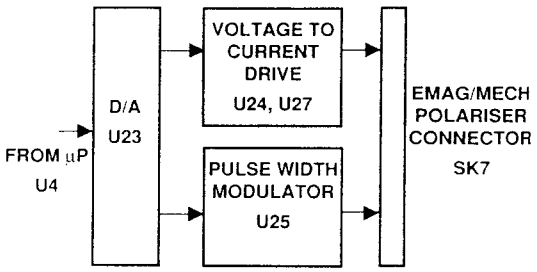
They also contain a 15/27 MHz dual bandwidth tuner (see page 4 of this addendum for part number details).

**NOTE:** unlike the other receivers in the MSS 200 series, **the MSS 248-GR has two LNB inputs.**

## INTEGRAL POLARISER CIRCUITRY

Both the electromagnetic and mechanical polariser are controlled by data from the microprocessor U4 which is passed, for storage, to U23 via strobe, data and clock lines on pins 1, 2 and 3 respectively. U23 and the R-2R resistor ladder network form a D/A converter whose output is buffered by U24B.

The input to pin 3 of U24B is a static voltage whose level is proportional to the polarisation offset (total of base plus skew) which has been set in the menus. The voltage at pin 5 of U24A is also proportional to the polarisation offset, but is at a much lower level, as it is attenuated by R411 and R412.



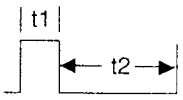

### Electromagnetic Option

The constant current output to the electromagnetic polariser (i.e. at pins 1 (+ve) and 2 (-ve) of SK7) varies linearly from -90 mA to +90 mA with a 6 bit resolution. Bit 6 sets pin 12 of U23 and controls the direction of the output current via U27, which is a DC motor driver IC. Pin 5 of U27 sets a "forward" direction and pin 6 sets a "reverse" direction.

U24A acts as a difference amplifier. Any current output from U27 flows out at pin 1 and then to ground via R413. This generates a reference voltage on pin 6 of U24A. The voltage from the R-2R ladder is divided down by R411 and R412 to generate a drive voltage on pin 5 of U24A. The voltage difference between pins 5 and 6 is amplified by U24A and the output on pin 7 is used to drive U27 to give the correct output current. This is a feedback network; as the voltage on pin 5 of U24A increases, the voltage on pin 7 increases causing U27 to deliver more current , which in turn forces up the voltage on pin 6 of U24A.

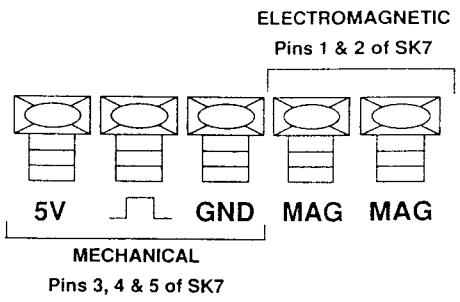
### Mechanical Option

Output to the mechanical polariser (i.e. at pins 3, 4 and 5 of SK7) is a pulse width modulated signal derived from U25. The time period, t1, varies linearly between 0.8 and 2.2 ms with 6 bit resolution. The resistor network R410, R424, R578 and R580 sums the output from the D/A converter (i.e. at pin 1 of U24B) with the logic level on pin 12 of U23 and sets the bias on the control pin 5 of U25. At pin 4 of SK7 there are pulses whose width (t1) is proportional to the voltage on pin 5 of U25.




The bias on pin 5 of U25 is compared with the voltage on pin 6 which is derived from the timing components R582 and C273, to define period t1. The combination of timing components R583 and C275 with the bias signal defines a period t2, which is initiated when the output pulse at pin 3 of U25 drops. At the end of t2, the level at pin 7 of U25 also decreases due to the discharge of C273. This allows the start of the next period.

When a programme is selected, the output pulse train is only active for 4 seconds before the microprocessor U4 (via U23) resets U25. In set-up mode the pulse train is maintained while the binary value is changed.



# CIRCUIT DESCRIPTION (FOR NON-VIDEOCRYPT RECEIVERS)

The circuit description on pages 14 to 25 inclusive of the main MSS 200-I Service Manual is for a receiver which has an integral VideoCrypt decoder. Most of that description also applies directly to receivers without the decoder, but there is a different sync. separator and control lines CLMP_REF and VC_STATUS are different.

## Clamp Reference

As there are no VideoCrypt ICs, there is no CLMP_REF line from the VideoCrypt circuitry to provide the clamp reference at the base of Q45 (and R279, Q46 are not fitted). Instead, R277 is fitted, and this, together with R275 and R276 form a divider from the 5 V line to set the reference voltage at the base of Q45.

## Decoder Selector Switch

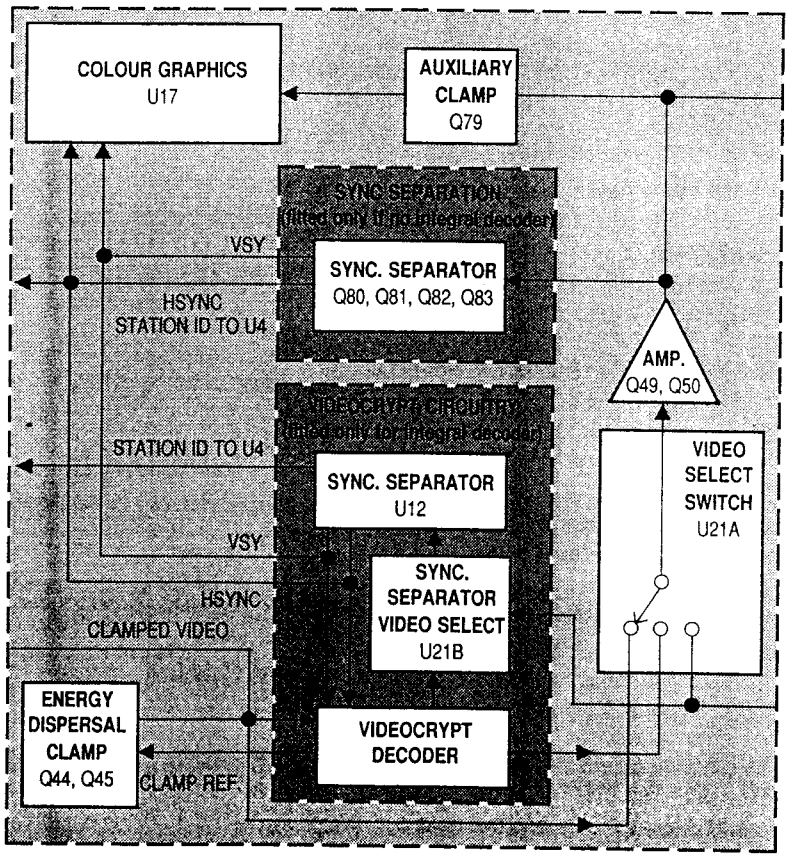
At the decoder selector switch U21A, if pin 9 is low, then "internal" video is switched through and in theory this could be from pin 12 or from pin 14. These pins are under the control of the VC_STATUS line on pin 10, but this is always low because, in the absence of the VideoCrypt ICs, C126 is fitted as a zerohm link. Therefore when pin 9 of U21 is low, pin 12 is always switched to pin 13. U21A therefore passes the "internal" video from the energy dispersal clamp or the "external" video from the external decoder, controlled by the line INT/EXT_VIDEO being low or high respectively. Pins 1 to 5 of U21 (U21B) are not used.

## Sync. Separator

The sync. separator for receivers without an integral decoder comprises Q80, Q81, Q82, Q83 and associated components. Q81 is lightly biased on, but, in the presence of a clamped video signal coming in via C227, the positive-going video signal switches off Q81 by reverse biasing its base. When the negative-going sync. pulses arrive however, these switch Q81 hard on so that only the sync. pulses appear at the collector of Q81. The video signal is therefore stripped off to leave the sync. pulses.

The horizontal sync. pulses (HSYNC) are then inverted and buffered by Q83. A low-pass filter comprising R432 and C229 with R434 and R435 extracts the vertical sync. pulses (VSY), which are then inverted and buffered by Q82. Transistor Q80 is a buffer driver for the sync. pulses.

As there is no VideoCrypt IC giving the "station ID" line to indicate a valid video signal, the main microprocessor U4 performs this function by analysing the horizontal sync. pulses which pass via a mod. wire (see the notes on page 4 of this addendum) to enter U4 at pin 39 (line ID_HSYNC). U4 can detect the presence of a 15.625 kHz signal and, if it detects this signal, it follows that there must be a valid signal ("station") which is generating the sync. pulses. The microprocessor U4 has a certain amount of hysteresis in its decision-making so that it can analyse noisy signals. R592 is not fitted for non-VideoCrypt receivers; this informs U4 that it has to analyse the horizontal sync. pulses.



# ADDITIONAL PARTS LIST FOR MSS 248-GR AND MSS 348-GR RECEIVERS

This is all those parts of the MSS 248-GR and MSS 348-GR which are concerned with the polariser circuitry and the additional AV phono sockets. (* = also fitted on all the other models in the MSS 200 and 300 series.)

## Capacitors

| | | |
|---|---|---|
| C120 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C272 | 1UF 16V 5MM RADIAL ELECT' CAP TR | 155-1051751 |
| C274 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C276 | 100UF 16V 5MM RADIAL ELECT' CAP TR | 155-1071751 |
| C280 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C281 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C286 | 10UF 16V 5MM RADIAL ELECT' CAP TR | 155-1061751 |
| C287 | SMD 330NF 25V 20/80% CER Y5V CAP 0805 TR | 950-3342951 |
| C288 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C296 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C297 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C298 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |
| C311 | SMD 0.1UF 25V 20/80% CER Y5V CAP 0805 TR | 950-1042951 |

## Diodes

| | | |
|---|---|---|
| D57 | SIGNAL DIODE IN4148 75MA 75V TR | 120-0414801 |

## Inductors

| | | |
|---|---|---|
| L42 | AXIAL INDUCTOR - 18UH 5% 0.5MM | 130-0180501 |

## Links

| | | |
|---|---|---|
| LK186* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |
| LK262* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |
| LK263* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |
| LK264* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |
| LK266* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |
| LK272* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |
| LK302* | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |

## Connectors

| | | |
|---|---|---|
| SK6 | PHONO SOCKET- DUAL (PEDOKA HSP-202V-16) Y/B | 165-2000230 |
| SK7 | FE CONNECTOR - 5 WAY TOP ENTRY JST | 161-2000510 |

## Transistors

| | | |
|---|---|---|
| Q19 | SMD TRANS-BC846B/2SC2412KT146R SOT-23 | 911-1084651 |

## Resistors

| | | |
|---|---|---|
| R162 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R163 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R221 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R399 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R400 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R401 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R402 | SMD 10K 0.1W 5% RES 0805 (TRS) | 940-1030501 |
| R403 | SMD 10K 0.1W 5% RES 0805 (TRS) | 940-1030501 |
| R404 | SMD 10K 0.1W 5% RES 0805 (TRS) | 940-1030501 |
| R405 | SMD 10K 0.1W 5% RES 0805 (TRS) | 940-1030501 |
| R406 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R407 | SMD 20K 0.1W 5% RES 0805 (TRS) | 940-2030501 |
| R408 | SMD 10K 0.1W 5% RES 0805 (TRS) | 940-1030501 |
| R409 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R410 | SMD 18K 0.1W 5% RES 0805 (TRS) | 940-1830501 |
| R411 | SMD 10M 0.1W 5% RES 0805 (TRS) | 940-1060501 |
| R412 | SMD 1M1 0.1W 5% RES 0805 (TRS) | 940-1150501 |
| R413 | SMD 3R9 0.1W 5% RES 0805 (TRS) | 940-0390501 |
| R423 | SMD 100K 0.1W 5% RES 0805 (TRS) | 940-1040501 |
| R424 | SMD 10K 0.1W 5% RES 0805 (TRS) | 940-1030501 |
| R475* | SMD 75R 0.1W 5% RES 0805 (TRS) | 940-7500501 |
| R489 | SMD 3K3 0.1W 5% RES 0805 (TRS) | 940-3320501 |
| R490 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R549* | SMD 0R0 0.1W 5% RES 0805 (TRS) | 940-0000501 |
| R577 | SMD 0R0 0.1W 5% RES 0805 (TRS) | 940-0000501 |
| R578 | SMD 5K1 0.1W 5% RES 0805 (TRS) | 940-5120501 |
| R579 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R580 | SMD 15K 0.1W 5% RES 0805 (TRS) | 940-1530501 |
| R581 | SMD 4K7 0.1W 5% RES 0805 (TRS) | 940-4720501 |
| R582 | SMD 5K6 0.1W 5% RES 0805 (TRS) | 940-5620501 |
| R583 | SMD 120K 0.1W 5% RES 0805 (TRS) | 940-1240501 |
| R584 | SMD 1K 0.1W 5% RES 0805 (TRS) | 940-1020501 |
| R585 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |
| R590 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |
| R591 | SMD 6K8 0.1W 5% RES 0805 (TRS) | 940-6820501 |

## Integrated Circuits

| | | |
|---|---|---|
| U23 | CD4094BCN 8 BIT SHIFT AND STORE REGISTER | 106-0409400 |
| U24 | TLC272CP DUAL CMOS OP AMP LOW BIAS (TI) | 100-0027201 |
| U25 | 555 CMOS SINGLE TIMER (8 DIP PACKAGE) | 100-0055501 |
| U27 | REVERSIBLE DC MOTOR DRIVER BA6109 | 107-0610900 |

## Miscellaneous Components

| | | |
|---|---|---|
| REG1 | V/REGULATOR-LM78M05 +5V 0.5A -T0220 | 105-0780500 |
| REG2 | V/REGULATOR-78L12 +12V 100MA TO-92 | 105-1781200 |

## PCB for Polariser Connector and its components

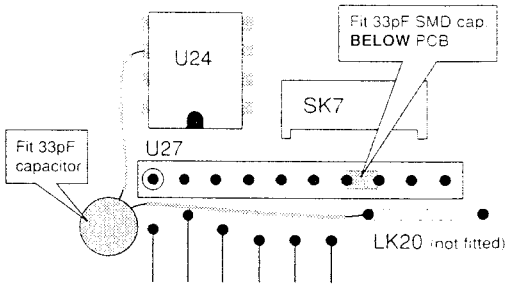
| | | |
|---|---|---|
| | PCB - IRTE 5 POLE PUSH CONNECTOR ASSY | 181-0333101 |
| C1 | 1000UF 16V 5MM RAD ELEC' CAP (10X16) | 155-1081750 |
| C2 | 1000UF 16V 5MM RAD ELEC' CAP (10X16) | 155-1081750 |
| PL1 | FE CONNECTOR - 5 WAY TOP ENTRY | 161-2000510 |
| R1 | 2R2 1W 5% CARBON FILM RES TR | 140-0226501 |
| SK1 | CHAP/IRTE 5 POLE PUSH TERMINAL "CUSTOM" | 163-5000501 |

## Retrofitted Components (Diagram 1)

| | | |
|---|---|---|
| 1 OFF | 33PF 100V5% CERAMIC CAP | 150-3307551 |
| 2 OFF | 15MM SILICONE SLEEVING | 203-1150100 |
| 1 OFF | SMD 33PF 50V 5% CER COG CAP 0805 | 950-3305501 |

### Diagram 1

PCB (Component Side)

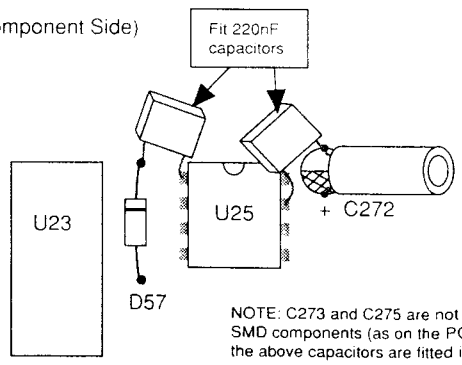



## Retrofitted Components (Diagram 2)

| | | |
|---|---|---|
| 2 OFF | 220NF 63V 5MM BOX POLYESTER CAP TR | 152-2246551 |

### Diagram 2

PCB (Component Side)




NOTE: C273 and C275 are not fitted as SMD components (as on the PCB ident); the above capacitors are fitted instead.

# UPDATING MSS 200-I SERVICE MANUAL TO 11.11.94

## PARTS LISTS - CHANGES BETWEEN 17.08.94 AND 11.11.94

**These changes have occurred to the mechanical parts:**
The Addendum Sheet is no longer packed as the User Manual has been re-issued and is now:

| | | |
|---|---|---|
| 1 OFF | "A"MANUAL MSS200-I S/LNB PAL-I PACE ISS2 | 502-2010101 |

The packaging has changed and now comprises:

| | | |
|---|---|---|
| 1 OFF | CARTON-MSS200 BRANDED PACE (POLY SIZE) | 412-0200100 |
| 2 OFF | POLYSTYRENE MSS200 SERIES | 442-2300100 |
| 1 OFF | BAG-POLYTHENE FOR MKII SAT REC 14X17 | 400-1141700 |

One pillar (part no: 248-0014002) has been removed.
There is a new base for MSS 200/300 series receivers (PCO S000348) :

| | | |
|---|---|---|
| 1 OFF | BASE - MSS200/300 UNIVERSAL ISS2 | 321-3000101 |

**Because of the fitting of the masked microprocessor, these changes have occurred (ECO S000754):**
The following components have been added:

| | | |
|---|---|---|
| U4 | 8663 PROC MSS200 IRD (809-8663205) | 809-8663205 |
| X1 | XTAL 16MHZ HC18U 50/50/-10+60 30PF PAR | 170-0160000 |
| C86 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| C87 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |

The 2 off sockets (part no: 161-2002001) and 1 off support (part no. 248-0014002) have been removed as has the U4 extension PCB.
As a result of the fitting of the masked part, R593 has changed as follows (to pull the sense line down harder - ECO S000790):

| | | |
|---|---|---|
| R593 | SMD 2K2 0.1W 5% RES 0805 (TRS) | 940-2220501 |

**L40 has been removed and these components have changed to the following values to minimise picture flicker (ECOs S000832 and S000850):**

| | | |
|---|---|---|
| C250 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| C283 | SMD 47PF 50V 5% CER COG CAP 0805 (TRS) | 950-4705501 |
| R396 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R529 | SMD 220R 0.1W 5% RES 0805 (TRS) | 940-2210501 |

**These resistors have been derated; their values have been changed as follows (ECO S000752):**

| | | |
|---|---|---|
| R32 | SMD 20R 0.1W 5% RES 0805 (TRS) | 940-2000501 |
| R147 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R161 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R212 | 2K7 0.25W 1% METAL FILM RES TR | 141-2722101 |
| R217 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R220 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R282 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R283 | SMD 1K8 0.1W 5% RES 0805 (TRS) | 940-1820501 |
| R362 | SMD 100R 0.1W 5% RES 0805 (TRS) | 940-1010501 |

**These resistors have changed their values as follows to reduce the load on gate output (ECO S000772A):**

| | | |
|---|---|---|
| R70 | SMD 1K2 0.1W 5% RES 0805 (TRS) | 940-1220501 |
| R71 | SMD 1K2 0.1W 5% RES 0805 (TRS) | 940-1220501 |

**To prevent reduced bandwidth on SVHS Chroma loop-through, R378 has changed as follows (ECO S000772A):**

| | | |
|---|---|---|
| R378 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |

**Introduction of a custom resonator for X3, as follows, also results in the removal of L17 from the board (ECO S000562A):**

| | | |
|---|---|---|
| X3 | RESONATOR-494.6KHZ TYPE CSB500F47 | 171-0004940 |

**C245 and C246 have been removed and the components below have changed to minimise frame buzz on UHF audio (ECO S000733):**

| | | |
|---|---|---|
| C39 | SMD 10PF 50V 5% CER COG CAP 0805 | 950-1005501 |
| L38 | TINNED COPPER WIRE LINKS 0.61MM DIA-PMF | 999P1099901 |
| R73 | SMD 150R 0.1W 5% RES 0805 (TRS) | 940-1510501 |
| R379 | SMD 150R 0.1W 5% RES 0805 (TRS) | 940-1510501 |

**These capacitors have changed to 2% tolerance to tighten the specification for PAL/MAC video de-emphasis (ECO S000803):**

| | | |
|---|---|---|
| C222 | SMD 390PF 50V 2% CER COG CAP 0805 (TRS) | 950-3915201 |
| C223 | SMD 390PF 50V 2% CER COG CAP 0805 (TRS) | 950-3915201 |
| C225 | SMD 100PF 50V 2% CER COG CAP 0805 (TRS) | 950-1015201 |

**Q45 has changed as follows to improve clamping and thereby prevent possible frame roll with certain TV types (ECO S000759):**

| | | |
|---|---|---|
| Q45 | SMD TRANSISTOR-FMMT2369A SOT-23 | 911-0236951 |

**These resistors have changed as follows to reduce the factory default volume setting which was too high at the TV SCART (ECO S000785):**

| | | |
|---|---|---|
| R243 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R245 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |
| R247 | SMD 470R 0.1W 5% RES 0805 (TRS) | 940-4710501 |
| R249 | SMD 10K 0.1W 5% RES-0805 (TRS) | 940-1030501 |

**All wire links have been changed as follows (PCO S000372):**

| | | |
|---|---|---|
| | TINNED COPPER WIRE LINKS 0.61MM DIA | 999-1099902 |

**These components have changed to the following values to ease manufacture (PCO S000342):**

| | | |
|---|---|---|
| C58 | 1000UF 25V DJ3 RADIAL ELECT CAP 5MM | 855-1082950 |
| C73 | 1000UF 25V DJ3 RADIAL ELECT CAP 5MM | 855-1082950 |
| C89 | 1000UF 25V DJ3 RADIAL ELECT CAP 5MM | 855-1082950 |

## HAND MODIFICATIONS BETWEEN 17.08.94 AND 11.11.94

**The first modification was to remove 3.5 MHz clock lines which were visible on SKY 2 on some sets (ECO S000772A). This involved the removal of C130 and C133 and the retrofitting of the following capacitor between the links LK125 and LK129:**

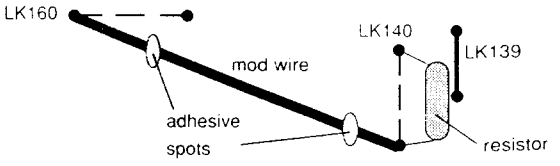
| | | |
|---|---|---|
| | 47NF 50V 5MM CERAMIC CAP TR | 150-4735951 |

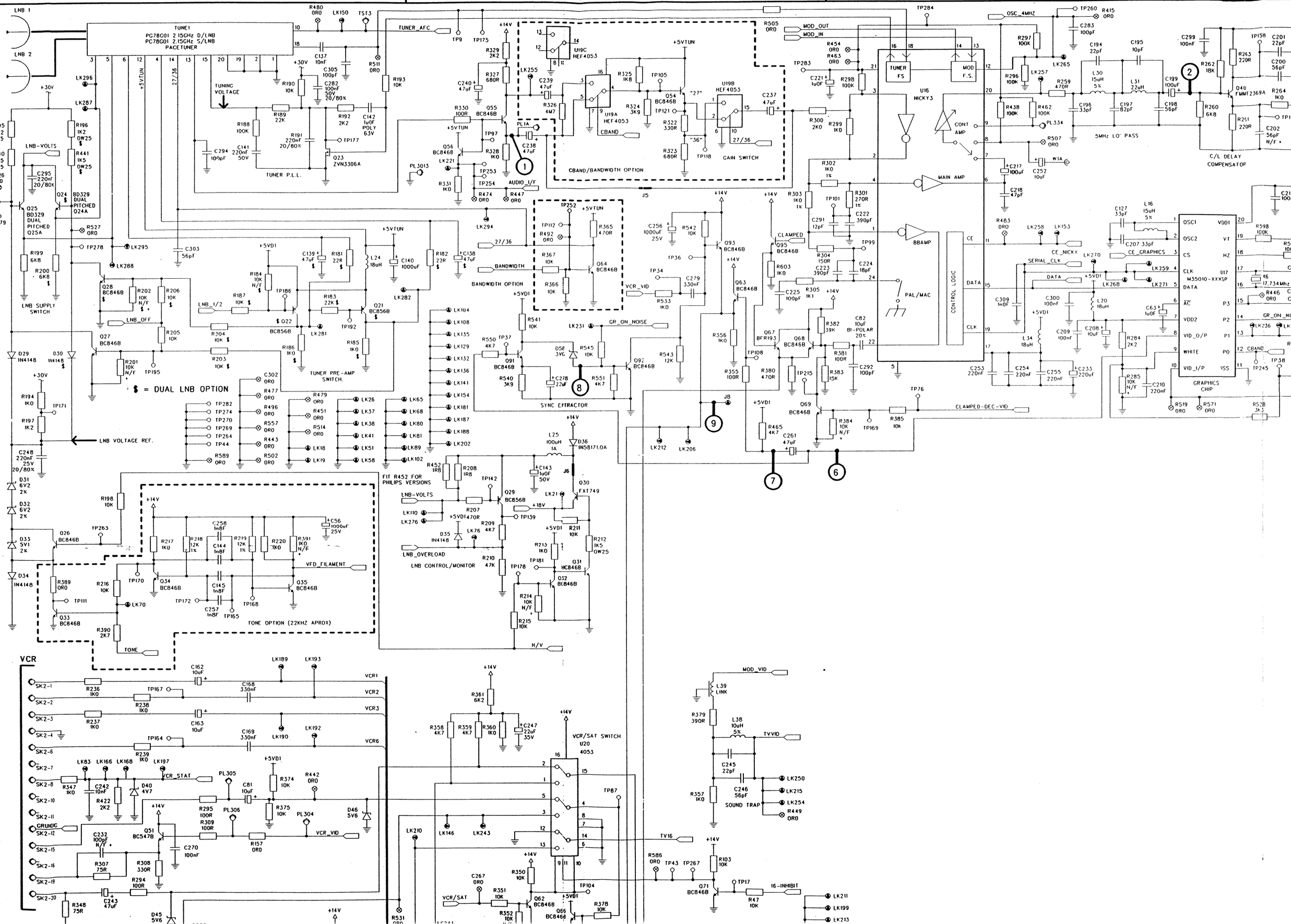
**The second modification was to remove audio crackle which can occur at the TV SCART when the receiver is in standby or when there is VCR playback. The modification reduces the 5 V supply to U14 as follows (ECO S000742):**
LK160 was removed and LK140 replaced by the following resistor:

| | | |
|---|---|---|
| LK140 | 3R3 0.25W 5 5% CARBON FILM RES TR | 140-0332501 |

A mod. wire of the following type was fitted between LK160 and LK140 as shown in the diagram and held with hot melt adhesive (ECO S000763A).

| | | |
|---|---|---|
| | MOD WIRE-0.5 X 60MM BLACK | 190-0506001 |
| | HOT MELT ADHESIVE STICK | 206-1059960 |




TUNER
PG78G01 2.15GHz D/LNB
PC78G01 2.15GHz S/LNB
PACETUNER
LNB 1
LNB 2
TUNING VOLTAGE
TUNER P.L.L.
TUNER_AFC
TUNER FS
MOD F.S.
U16 NICKY3
CONT AMP
MAIN AMP
BBAMP
PAL/MAC
CONTROL LOGIC
CE
DATA
CLK
OSC_4MHZ
5MHz LO' PASS
C/L DELAY COMPENSATOR
MOD_OUT
MOD_IN
LNB-VOLTS
LNB SUPPLY SWITCH
LNB_OFF
LNB_1/2
TUNER PRE-AMP SWITCH.
$ = DUAL LNB OPTION
LNB VOLTAGE REF.
CBAND/BANDWIDTH OPTION
GAIN SWITCH
AUDIO_I/F
BANDWIDTH OPTION
SYNC EXTRACTOR
GR_ON_NOISE
CLAMPED
CLAMPED-DEC-VID
SERIAL_CLK
DATA
CE_NICKY
CE_GRAPHICS
GRAPHICS CHIP
FIT R452 FOR PHILIPS VERSIONS
LNB_OVERLOAD
LNB CONTROL/MONITOR
TONE OPTION (22KHZ APROX)
VFD_FILAMENT
TONE
H/V
VCR
VCR1
VCR2
VCR3
VCR6
VCR_STAT
VCR_VID
VCR/SAT
VCR/SAT SWITCH U20 4053
MOD_VID
TVVID
SOUND TRAP
16-INHIBIT

Pace Micro Technology Ltd
Victoria Road • Shipley • BD18 3LF • England
Tel: +44 (0)274 532000 • Fax: +44 (0)274 532010

| OSD CHIP | |
|---|---|
| P0 | CBAND |
| P1 | LNB_1/2 |
| P2 | GR_ON_NOISE |
| P3 | CLAMPED-DEC-VID |

NON IRD OPTION (SYNC SEP)

ONLY FIT FOR VF DISPLAY.

POLARISER OPTION.

ANTENNA INPUT

TV INPUT

PHONO
TV
DEC
SK2
SK3
SK4
SK5-2
SK5-3
SK5-1
SK6-3 MONO
SK6-2 VIDEO
SK6-1
SK2-16
SK2-19
SK2-20
SK3-1
SK3-2
SK3-3
SK3-4
SK3-6
SK3-7
SK3-8
SK3-10
SK3-11
SK3-12
SK3-15
SK3-16
SK3-19
SK3-20
SK4-1
SK4-2
SK4-3
SK4-4
SK4-6
SK4-7
SK4-8
SK4-10
SK4-11
SK4-12
SK4-15
SK4-16
SK4-19
SK4-20
SK2-5
SK2-9
SK2-13
SK2-14
SK2-17
SK2-18
SK2-21
SK3-5
SK3-9
SK3-13
SK3-14
SK3-17
SK3-18
SK3-21
SK4-5
SK4-9
SK4-13
SK4-14
SK4-17
SK4-18
SK4-21
R307 75R
R308 330R
R294 100R
C243 47uF
R348 75R
D45 5V6
100nF
R577 N/F
R241 1K0
R240 1K0
R242 1K0
R244 39K
R591 N/F
R246 1K0
R248 39K
R250 100R
C268 100uF 25V
AUDIO AMP BUFFER
C281 N/F
TP262
R590 N/F
R475 75R
TP152
Q37 BC846B
R243 220R
TP163
R245 6K8
C173 10uF
Q38 BC846B
TP141
R247 220R
R249 6K8
C174 10uF
TP184
R
R232 1K0
C160 10uF
15
L
R234 1K0
R233 1K0
C161 10uF
C166 330nF
TV2
TV3
TV1
TV6
TP162
C167 330nF
LK208
R235 1K0
PL302
D62 12V
R335 100R
C241 10nF
TP114
R336 1K0
TP41
R337 10K
TP42
R338 10K
TV_STAT
PL309
+5VD1
Q57 BC846B
LK209
TV16
TP145
R332 75R
R334 10K N/F
R333 470R
Q58 BC846B
Q59 BC846B
R339 10K
+14V
LK207 5V6 5Y.400MW
+289 100uF 25V
DEC1161
TP100
R343 220R
R344 1K0
C269 100nF
TP96
TP95
Q60 BC856B
Q61 BC846B
R346 270R
R345 100R
W1B
R340 56R
R341 75R
R342 270R
12
TVVID
TP94
LK216
LK252
R228 1K0
C158 10uF
TP161
C164 330nF
DEC1
DEC2
DEC3
DEC6
LK251
R230 1K0
C159 10uF
R229 1K0
LK217
TP160
PL310
R231 1K0
C165 330nF
LK148
LK245
DISH_POS
LK149
LK246
R319 1K0
DEC_STAT
+5VD1
C235 1n0F N/F
D39 5V6
D41 5V6
R448 22K
R364 4K7
R363 470R
+14V
LK214 5V6 5%
+C290 100uF 25V
PL308
C234 150pF
Q52 BC856B
TP137
R314 100R
R315 1K0
C271 100nF
R318 33K
TP129
TP127
R316 100R
LK242
C80 10uF BI-POLAR 20%
LK249
R311 75R
PL312
R312 390R
R606 270R
TP148
R317 8K2
13
R320 33R
R321 43R
C236 10uF
TP285
DECODER VIDEO AMP
EXT_DEC
LK10
R349 470R
D43 5V6
D44 5V6
R373 470R
PL301
R461 4R7
Q86 BC557
R458 10K
REL_DRV
R457 4K7
R455 4K7
LK163
R459 1K
TP73
TP72
TP71
R460 1K
Q85 BC846B
R456 10K N/F
RELAY_DRIVE OPTION
+8V2
R251 220R 0W25
D37 8V2
+ C186 100uF
C187 100nF
TV3
TV1
R531 ORO
R586 ORO
TP43
TP267
R103 10K
C267 ORO
R350 10K
R351 10K
VCR/SAT
Q62 BC846B
R352 10K N/F
TP104
+5VD1
Q65 BC846B
R378 10K
TP88
R377 10K
TP17
16-INHIBIT
Q71 BC846B
R47 10K
+C244 100uF
R376 75R
LK204
R353 330R
R354 330R
LK211
LK199
LK213
LK220
LK218
LK233
LK253
LK247
LK241
LK238
LK298
LK297
LK293
LK286
LK301
LK180
+8V2
R253 10K
L28 12uH
C189 18pF
C190 100nF
R255 100R
R254 9K1 1%
C188 56pF
Q39 BC846B
C192 39pF
C193 39pF
R258 75R
AUDIO_I/F
R252 220R
R256 4K7
C191 270pF
R257 18K
L29 12uH
X5 MURATA TRAP
5-9MHz BAND PASS FILTER
14
AUDIO PROCESSOR AND ROUTING
U14 MSP3410
PL339
PL338
X4 18.432MHz
C170 10pF
C171 10pF
C172 56pF
C175 100nF
C176 220nF
C177 100nF
C178 10uF
J2 ORO
MAC1 N/F
J3 ORO
MAC2 N/F
C179 470pF
C180 470pF
C181 100nF
C182 3u3F
C185 100nF
C183 10uF
C184 10uF
CONTROL O/P PORTS
INT/EXT_VIDEO
VCR/SAT
C147 100nF
R72 ORO N/F
I2C_CLK
DATA
R529 ORO
LK143
LK145
LK158
LK274
LK198
AUDIO RF/IF INPUT
AUDIO FROM VCR
AUDIO FROM MAC/TV
AUDIO FROM DECODER
AUDIO TO VCR
AUDIO TO DECODER
AUDIO TO TV
RESET
AUDIO TO MOD
VCR2
VCR6
TV2
TV6
DEC2
DEC6
VCR3
VCR1
DEC3
DEC1
LK196
LK195
MSP AUDIO CHIP
PIN 4 IN/EXT_VIDEO
PIN 5 VCR/SAT
PL336
PL337
PL3310
C148 10uF
C149 100nF
DEFAULT OPTION LINKS.
J4 N/F N/F = NO CBAND FIT = CBAND
J7 N/F = DUAL LNB FIT = SINGLE LNB
AUDIO_MOD
C155 1u0F POLY 6.3V
LK52
LK61
RST
C150 220nF
TP155
C154 22nF
R227 10K
R225 82K
Q36 BC846B
R226 2K2
R224 15K
C153 10uF
R222 6K8
R223 6K8
C151 220pF
C152 220pF
C264 1n0F
C156 1n0F
C157 1n0F
C266 1n0F
C265 1n0F
AUTH_SWITCH
N/F FOR VF DISPLAY
SW1B STBY
SW1A STBY N/F
SW2 CHAN+
SW3 CHAN-
SW4B AUTH
SW4A AUTH N/F
R546 N/F FIT FOR VF DISPLAY
VC_STATUS
VCR_STAT
LNB_OVERLOAD
U5 4052
LK290
LK260
LK72
R594 220K N/F
R371 220K
R82 220K
R493 4K7
R84 47K
R559 ORO
PORTCE
CARDDET I/P
H/V
TONE
CE_GRAPHICS
CE_NICKY
VC_RST
BANDWIDTH
TP265
R566 ORO
LK74
LK25
LK75
LK67
R573 47K
LK226
LK170
LK73
C306 1nF
LK36
R476 ORO
TP256
R562 ORO
TP257
R478 ORO
N/F FOR VF DISPLAY
IR1 IR-CAN
C88 100nF
17
R552 ORO
LK151
R504 47K
C90 33nF
+5VD1
GRUNDIG OPTION
R393 4K7
Q70 FMMT2369A
R395 4K7
GRUNDIG
R394 10K
TP116
R86 4K7
LK39
LK54
20
R85 47K
PL360
ID_HSYNC
VFD_INT
R503 47K
PL354
LK30
R592 4K7
PORT 3 I/P
PORT 1 O/P
28 BAR
U4 SOCKET 20WAY TOP ENTRY
STATUS SWITCHES DATA
PORT 2
PL355
TP235
18
R515 ORO
DATA
VFD/MAC_DATA
TUNER_AFC
IRTE_CE
DEC_STAT
DISH_POS
X1 16MHz
C87 22pF
C86 22pF
X2
R544 ORO
TP259
RESET
C310 1n0F
R600 ORO
TP174
LK155
LK159
RST
SERIAL_CLK
I2C_CLK
VFD_CLK
MAC/CRYPTO
PORT 3 O/P
PORT 0 O/P
19
PL353
CRYPT1-2
C84 100nF
C85 220uF
U7 24C32
E2ROM
C285 100nF
R444 4K7
R445 4K7
DATA
LK147
R593 10K
R87 100K
7SEG DECOD
DIVI
BAR
LK28
LK55
LK56
LK31
74LS
21
LK4
R567 ORO
TP214
TP258
TP220
U22A 74LS74
4 X DIV

| PORT 0 | | PORT 1 | | PORT 2 | | PORT 3 | |
|---|---|---|---|---|---|---|---|
| PIN | FUNCTION | PIN | FUNCTION | PIN | FUNCTION | PIN | FUNCTION |
| 0 13 | PORTCE | 21 | CHAR IN BCD F=BLANK | 31 | STATUS1 | 5 | CRYPTO/GRUND |
| 1 14 | CARD_DET | 22 | | 32 | SWITCHES | 39 | ID_HSYNC |
| 2 15 | H/V | 23 | | 33 | DATA | 12 | IR |
| 3 16 | TONE | 24 | | 34 | VFD/MACDATA | 30 | VFD/MAC_INT |
| 4 17 | CE_GRAPHICS | 25 | DIGIT 1 | 35 | TUNER_AFC | 29 | SERIAL_CLK |
| 5 18 | CE_NICKY | 26 | DIGIT 2 | 36 | IRTE_CE | 40 | I2C_CLK |
| 6 19 | VC_RST | 27 | DIGIT 3 | 37 | DEC_STAT | 10 | VFD_CLK |
| 7 20 | BANDWIDTH | 28 | BAR | 38 | DISH_POS | 4 | CRYPT/MAC_CLK |
| | O/P | | O/P | | I/P+O/P | | O/P+INT |

| EXPORT (U26) | |
|---|---|
| PIN | FUNCTION |
| 0 4 | CARDSEL |
| 1 5 | STBY |
| 2 6 | 16-INHIBIT |
| 3 7 | TV/STAT |
| 4 14 | LNB_OFF |
| 5 13 | REL_DRV |
| 6 12 | |
| 7 11 | |
| | O/P |

POLARISER OPTION.

IRTE MAGNETIC (POLARITY SWITCH)

U27 BA6109

U25 LM555 CHAPPARAL

REG1 LM78M05

REG2 78L12

U24B TLC272

U24A TLC272

U1 SL5066

U2 SP4633

U23 4094

U26 4094

MICRO EXPANDER PORT

U6 74LS47 7SEG DECODER DIVIDER

LED1 3 UNIT 7SEG DISPLAY

DISPLAY

U22A 74LS74

U22B 74LS74

4 X DIVIDER

RESET CIRCUIT

FIT ONLY FOR V.F. DISPLAY

U3 TEA2018

T2 *A* SM (MSS200/300)

T1 T3 Option MAINS FILTER

4 X IN4007

MOD_VID

MOD_IN

MOD_OUT

MOD TUNING VOLTAGE

TV INPUT

AUDIO_MOD

AUDIO BIASING

MOD P.L.L.

N/F FOR VFD DISPLAY

LED OPTION

16:9 LED OPTION (MAC)

ITEMS MARKED N/F* NEVER FITTED ON PRODUCTION MODELS.ITEMS ONLY INCLUDED TO ASSIST IN DESIGN LIMITS VERIFICATION

* C29 150pF = 6.5MHz
180pF = 5.5MHz

NOTES:
N/F = NOT FITTED
ALL 1N4148 SIGNAL DIODE 75MA 75V
ALL DIODES 400mW UNLESS OTHERWISE STATED.
ALL ELECTROLYTICS 16V UNLESS OTHERWISE STATED.
ALL 100nF CAPS 25V 20/80% UNLESS OTHERWISE STATED.
ALL RESISTORS 0.1W 5% UNLESS OTHERWISE STATED.
ALL CAPACITORS 50V 5% UNLESS OTHERWISE STATED.
ALL INDUCTORS 10% UNLESS OTHERIWSE STATED.
⊕— = WIRE LINK IN THE NET.
⊗— = ZERO OHM RESISTOR IN THE NET.
○— = TEST PAD IN THE NET.
NO PLUGS FITTED EXCEPT PL-1 FOR VF DISPLAY

CAUTION